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The Heating and Ventilating Magazine

A MONTHLY JOURNAL OF ENGINEERING PROGRESS

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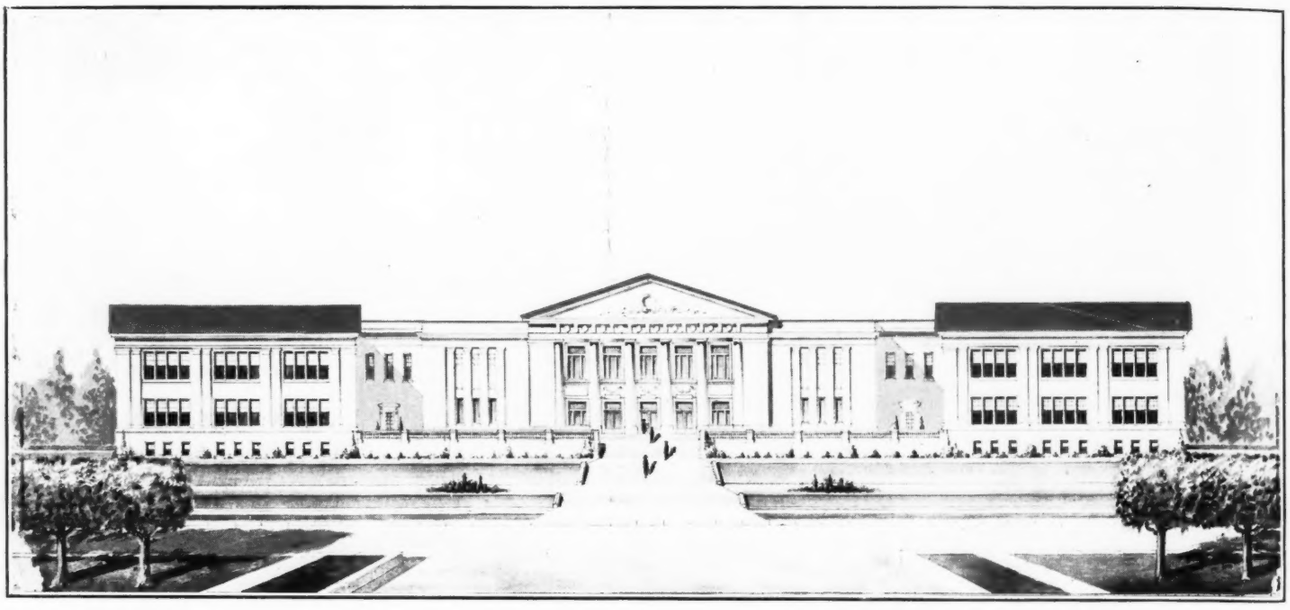

Architects—Jacobson & Jacobson
Owatonna, Minnesota

Htg. & Vent. Contractor— P. J. Gallagher
Faribault, Minn.

CLARAGE
KALAMAZOO
MULTIBLADE FANS

THE Northwest is noted for its good schools. Towns boasting of hardly five thousand people usually enjoy educational facilities vastly superior to smaller towns back East. Owatonna, Minnesota, is no exception to the rule; for here, the citizens have built a high school rivaling any school of its size in the country. This is the Owatonna Junior and Senior High School, shown above.

When the Frank Tustison Company of Minneapolis, the Engineers, were selecting mechanical equipment for this school building, they chose Clarage-Kalamazoo Multiblade Fans for ventilating. These Engineers chose Clarage fans because Clarage-Kalamazoo Multiblade Fans are dependable. Not only are the fans capable of delivering large volumes of air at low speeds and with small consumption of power, but these Multiblade fans are so built and so constructed that they will give years of faithful service, without the necessity for any repairs.

Write for catalog No. 51.

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Des Moines—602 Hubbell Bldg.
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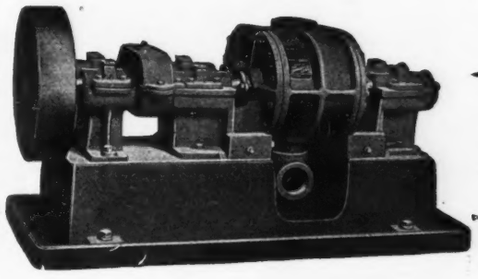
Kalamazoo, Michigan

Economy



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Economy in a vacuum heating system is determined to a greater extent by service than by first cost. Users of Connersville Vacuum Pumps have found that with little attention they continue to run year after year, giving the same dependable service, each succeeding season.

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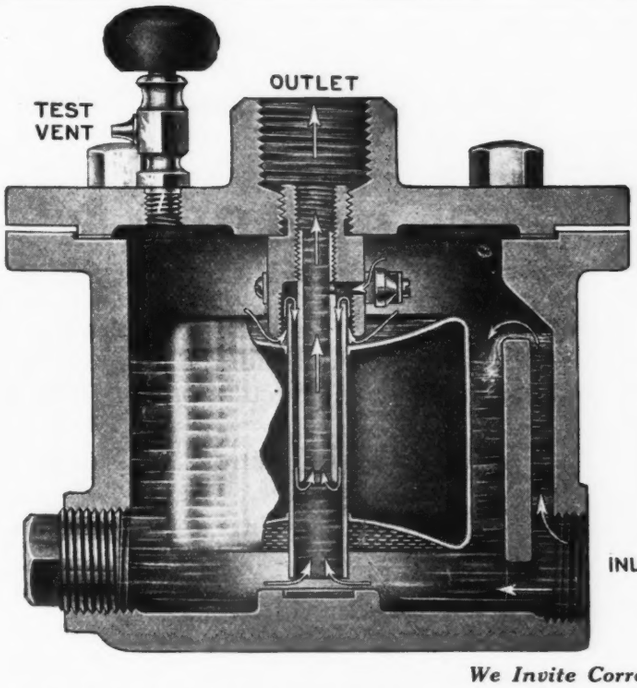
Connersville Indiana U.S.A.

Chicago, Monadnock Block New York, 114 Liberty Street



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FOR DIRECT OR INDIRECT COILS OR ANY LOCATION WHERE LARGE QUANTITIES OF WATER ARE TO BE DISCHARGED

Operates automatically either with or without mechanical suction on return line.

No complicated parts to stick or get out of order.

No small openings to clog up with sediment or scale.

Free passage of water—rapid and steady vent of air and passes no steam.

Combined action of flotation for water and all metal thermostatic vent for air together with relief of air through water seal makes the ideal trap for heavy service.

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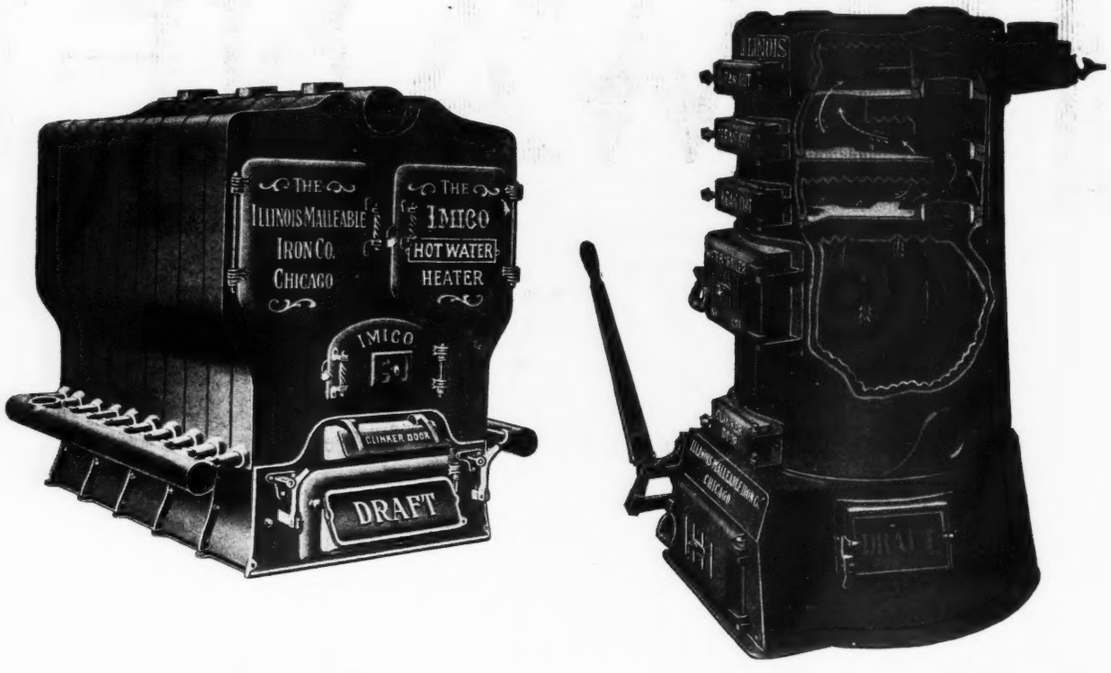

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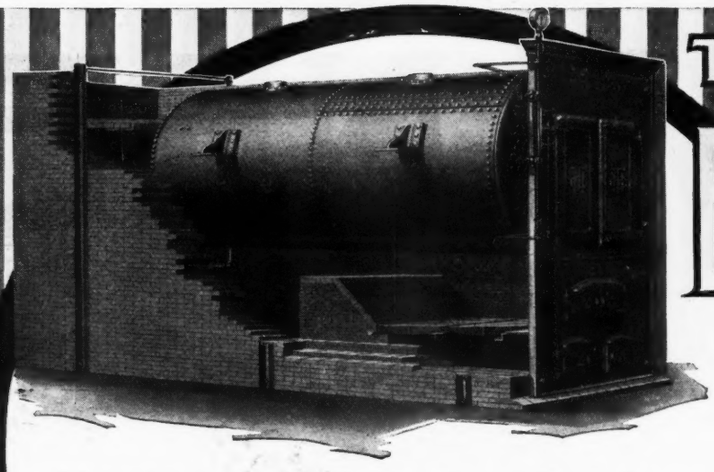

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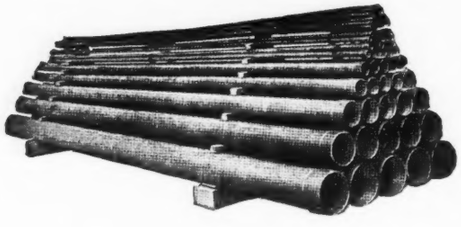

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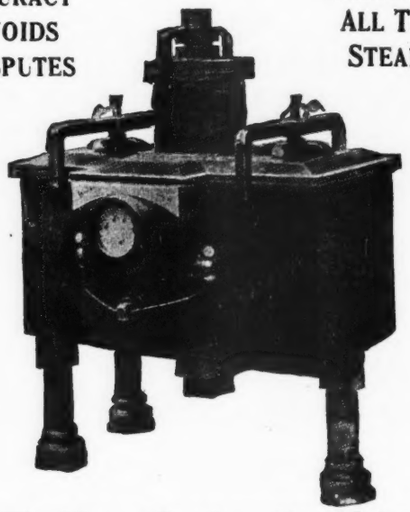

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1.—Tempering coils may be omitted.

2.—Boiler capacity may be reduced.

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The power consumed by the apparatus is extremely small, being only about 120 watts maximum for a 25,000 cu. ft. (per minute) machine when operating on alternating current. Based on an energy cost of 10c per kw. hr., this would give a cost of 12c per 10-hour day.

We will be pleased to send literature on this subject to anyone interested.

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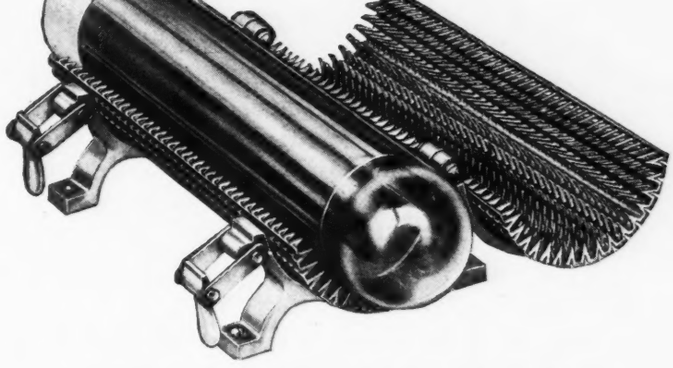

One complete unit capable of properly ozonizing 1000 cu. ft. of air per minute. The unit is shown open to illustrate simplicity of construction and ease of cleaning.

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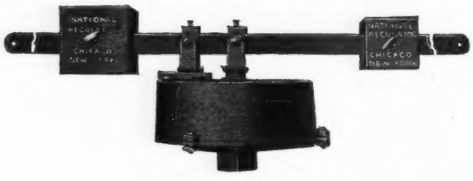
2" for Hot Water



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A Steam Trap that Automatically Eliminates Air and Water Condensation Without Allowing Escape of Steam

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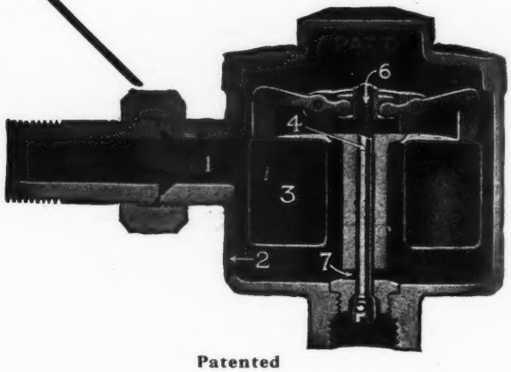

Patented

Leading architects, heating engineers and contractors are specifying and installing large numbers of the McDonald Under-Seat Valve, because its superior features have been proven in service.

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The McDonald Under Seat Valve Co.

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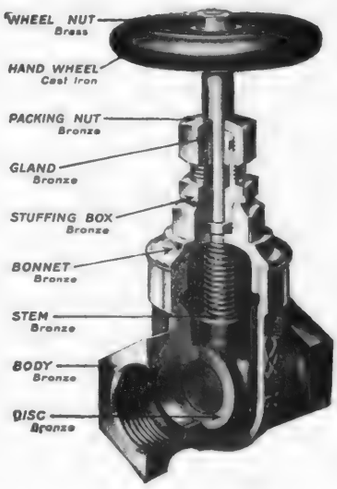
Read these Features of KENNEDY Bronze Valves



1. Wheel is held on by a nut, a much better construction than merely peering over the end of the stem. The Kennedy method permits the wheel to be lined up properly, eliminates the danger of losing the wheel during transit, and makes removal of the wheel possible and easy in service. Repacking a valve is much easier with the wheel removed.

2. Stem of special bronze of very high tensile and torsional strength.

3. Gland in stuffing box—an optional feature at slight additional cost, which keeps the packing nut from turning with the stem, avoids frequent repacking and makes the packing do good work until it is almost entirely used up.

4. Bonnet has a hexagonal shaped nut, which costs us more, but is much more satisfactory than a square wrench hold.

5. Body is semi-spherical or well-rounded which in comparison with a sharp cornered body, is the strongest obtainables with a given weight of metal.

6. Reinforcing ribs stiffen the body to withstand piping and service strains.

7. Pipe threads are of generous length. Short pipe thread mean that if a pipe is screwed in a little more than the average, it may press against the seat and the resulting distortion will promote leakage.

8. Discs are made solid in 3-inch and smaller sizes and double discs of three different styles are used in the larger sizes. This gives a proper choice for every service condition.

9. The discs of the double disc types cannot be replaced wrongly. Just because you have been lucky enough to escape trouble from valve discs replaced wrongly, don't get the idea that it can't happen or that it is unimportant.

10. Accurate guides for seat prevent contact of disc with seat until the valve is ready to close.

A satisfactory and permanent solution to the problem of good service from bronze valves depends largely upon your starting with the right valves. The selection of Kennedys assures good ervice. Write for the Kennedy Catalog to help you make a election for trial. 251

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The DUNHAM HEATING SERVICE
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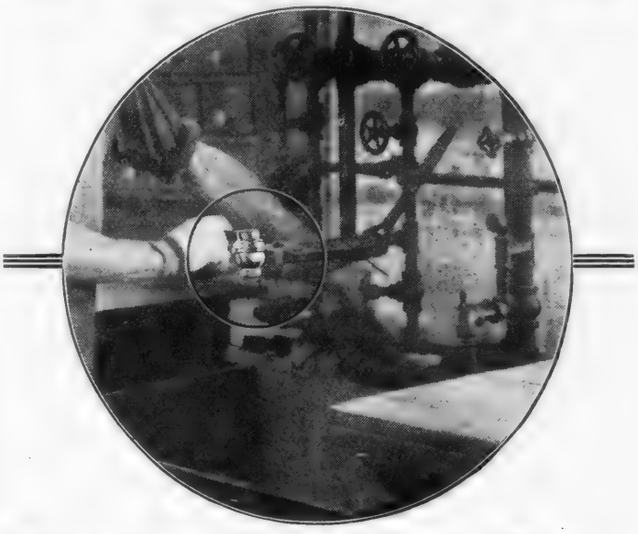


Testing Dunham Packless Valve for leakage

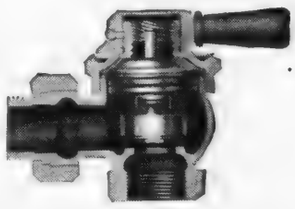
Every valve is tested under actual service conditions; then, under excess pressure. This tests the fit between disc and seat, and proves absolutely that the packless feature makes the valve leakless.

The Dunham Packless Radiator Valve utilizes a series of special metal diaphragms for allowing the free up and down movement of the spindle. No packing or stuffing boxes are necessary. On a vacuum system, air cannot leak in through this valve; neither can steam or water be forced out in a pressure system, these are stopped by the tough, flexible metal of the diaphragms.

The quick-opening and closing feature is valuable; seven-eighths of a turn does the work. The pleasing lines make the valve harmonize with the radiator. Made in angle pattern lever handled type; for steam only.

Full details of the Dunham Packless Valve, and other Dunham specialties, are given in the 15th edition of Sweet's Index, and in McRae's Blue Book.

The body of the Dunham Packless Radiator Valve is constructed of red brass, the handle of cocobolo, and the diaphragms of a special composition disc are furnished with each valve. Made in angle pattern lever handled type.



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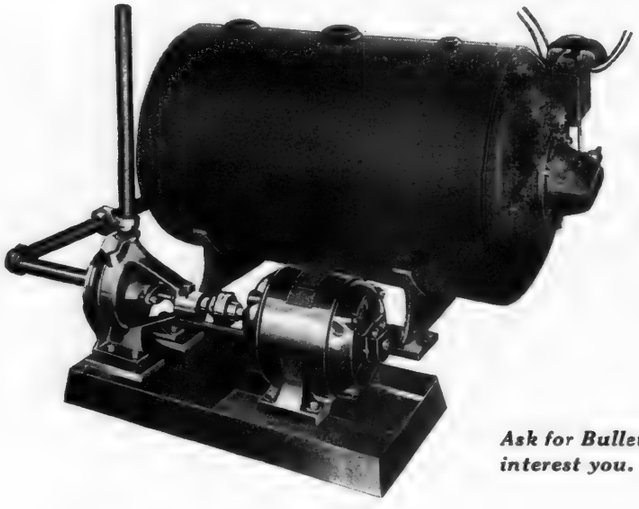
The Right Pump for the Job

That is the principle on which the success of Trane Pumping equipment has been built. We have not been satisfied merely to design and build good pumps, to rate them conservatively, and to equip them with the best motors, switches, tanks, etc. that it is possible to secure. We make it our business to know that every pump that leaves our factory is the right pump for the job.

Every Trane Pump is tested and a performance curve recorded for our file before it leaves our factory. You can have a copy of this test if you wish. It is the record of performance of the particular pump which you get. It shows exactly what that individual unit will do under the service conditions for which it is intended.



That is why Trane Pumps are a success. They are absolutely dependable. We know, and engineers who have used them know, that Trane Pumps will always do all that is expected of them, and a little bit more. A trial will convince you. One installation will make ***you*** a regular user of Trane Pumps.

Ask for Bulletin No. 2. The unusual listing of Trane Pumps will interest you. It is another step in insuring the right pump for the job.

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LIVE OUTDOORS INDOORS

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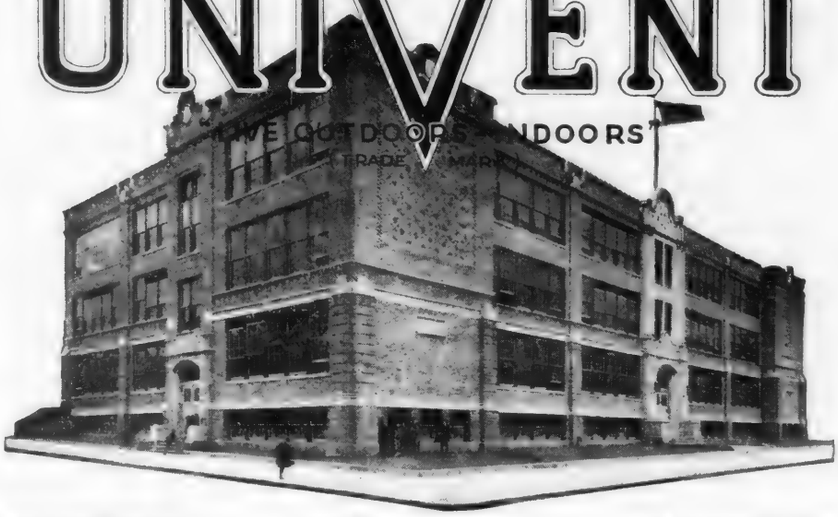

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Nothing but good words

The heating and ventilating contractor and engineer is conscientious—he wants to install a heating and ventilating system that will be a credit to his judgment, one that will never get out of order and one that will save his client money.

Install Univents and your judgment will gain nothing but praise. No comebacks. No after adjustments. Nothing but complete satisfaction everywhere.

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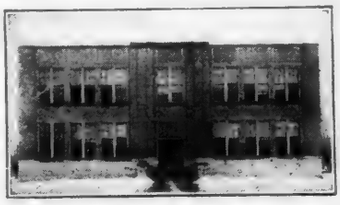
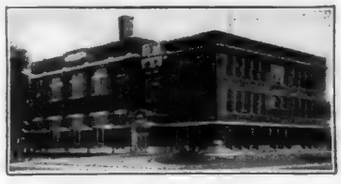
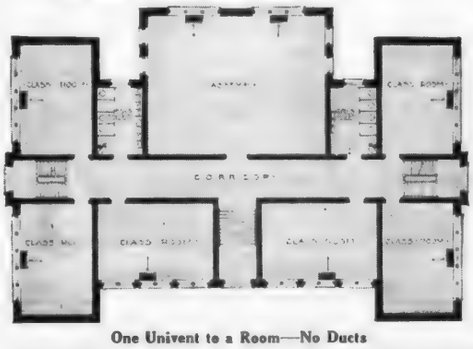


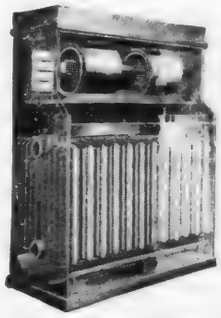
Grade School, Rexburg, Idaho
C. A. Sunberg, Archt., Rexburg, Idaho
A. H. Nelson, Contr., Rexburg, Idaho



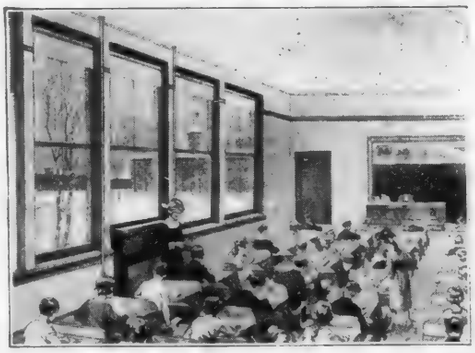
Washington School, Rock Island, Ill.
Gervin & Horn, Archts., Rock Island, Ill.
Ward & McMahon, Contrs., Rock, Island, Ill.



One Univent to a Room—No Ducts



Phantom View of Univent



Classroom Showing Univent Installations—Note Size

ADSCO HEATING SAVES COAL

NOTE the Adsco Graduated Radiator Valve—the only valve on each radiator. It absolutely controls the amount of steam entering the radiator. With it you can admit just a thin layer of steam along the top of the radiator to take the chill off. You can fill the radiator to any extent desired with steam.

This perfect control of steam, in connection with the automatic regulation of the fire by the Adsco Damper Regulator, saves a ton of coal in every 3½ to 5 tons.

Adsco Graduated Radiator Valve

Costs Less to Buy

because of the fact that Adsco Heating uses no radiator traps, no air valves, no vacuum pumps, no complicated unnecessary devices. Free from those costly annoyances Adsco Heating can be bought and installed for 15 to 20% less than most other systems. It is easy to change hot water systems to Adsco Heating. (Bulletin 147-H tells how.)

AMERICAN DISTRICT STEAM COMPANY
GENERAL OFFICES AND WORKS
NORTH TONAWANDA, N.Y.

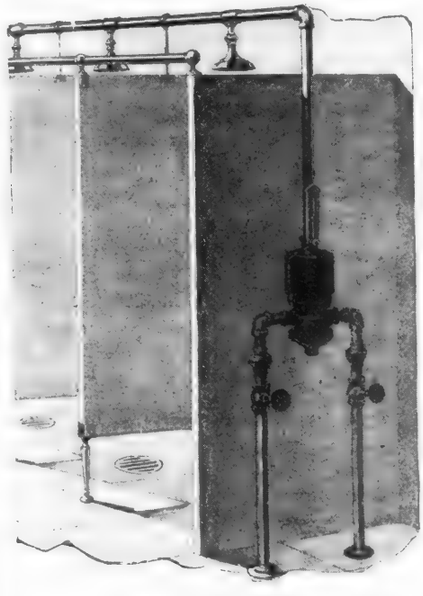
AGENCIES:

First National Bank Bldg. CHICAGO
Barclay Sales & Engineering Co. 1777 Woolworth Bldg. NEW YORK
Hoge Bldg. SEATTLE
The HarPer Company, 2A Park St BOSTON, MASS.
The Schley & Nash Co., 1404 Arrott Bldg. PITTSBURG, PA.

Ask about Adsco Heating for building groups from Central Station Steam Plant — Bulletin 20-H; for individual buildings, Bulletin 150-H.

ADSCO HEATING

Accident Prevention Saves Time Money and Suffering



GANG SHOWERS

Wash Sinks and Shower Baths should be made safe against scalding by the use of

The Powers Hot Water Line Controller

Scalding water cannot pass through this controller, but it will deliver water at any desired temperature below the danger point. Provided with variable or locked adjustment. Failure of either the cold or hot water shuts off the supply.

Economical, easily installed, handsomely finished. Saves fixtures, too.

The Powers Steam and water mixer is also very effective for supplying Shower Baths and Wash Sinks with warm water. Especially applicable when hot water tanks are inadequate for any reason, as it mixes cold water and live steam, requiring only one line of piping. Thermostatically controlled against overheating.

Ask for Bulletin 137

THE POWERS REGULATOR CO
Specialists In Automatic Heat Control

954 Architects Bldg., NEW YORK 2718 Greenview Ave., CHICAGO
565 Wharf Building, BOSTON

The Canadian Powers Regulator Co., Ltd.
TORONTO, ONT.

(1001 A)

Climate
Manufactured to suit your Product

An Engineering Force That Can Solve Your Weather Problems

What kind of a plant are you working on now?

Whether it be a

Bakery
Candy factory
Chocolate or Cocoa Factory
Celluloid Factory
Cold Storage Plant
Dyeing, Bleaching and Finishing Plant
Enamel Ware Works
Fur Storage Plant
Power Generating Station
Macaroni Factory
Motion Picture Plant
Paper Making Plant
Printing and Binding Shop
Photographic Materials Works
Rubber Factory
Textile Mill

or any industrial plant where weather conditions enter into economic operation, we can put at your disposal an Engineering Force that can give you the cumulative benefit of 60 years' experience in Air Conditioning Engineering.

Our Engineering Force works with the Construction Engineer, Contractor, or Architect and we GUARANTEE to reproduce for your client ideal working weather inside his plant 365 days in the year. A guarantee of this kind, backed by the reputation and resources of the B. F. Sturtevant Company, is a real GUARANTEE.

For detailed information on our Engineering Service see page 41 of our new complete Air Conditioning Bulletin No. 278.

B. F. STURTEVANT COMPANY
Hyde Park Boston

STURTEVANT APPARATUS IS INSTALLED BY W.L. FLEISHER CO. ENGINEERS NEW YORK

Sturtevant
PUTS AIR TO WORK

LAVIGNE

Lavigne Packless Wood Wheel Handle

PACKLESS QUICK-OPENING STEAM RADIATOR VALVES

are designed for service on Vapor, Vacuum, Central Station, and Low Pressure Heating Installations. They have double washers of non-deteriorating composition; are independent of metal joints; always stay tight. The extra large handle remains cool, preventing the hand from coming in contact with heated metal parts, and is fastened with one accessible screw to cast lugs which are a part of the valve itself, thus eliminating separate handle pieces.

BUILT RIGHT—TO STAY TIGHT

Made in six sizes, many styles of handles

All good jobbers handle them

COMMONWEALTH BRASS CORPORATION

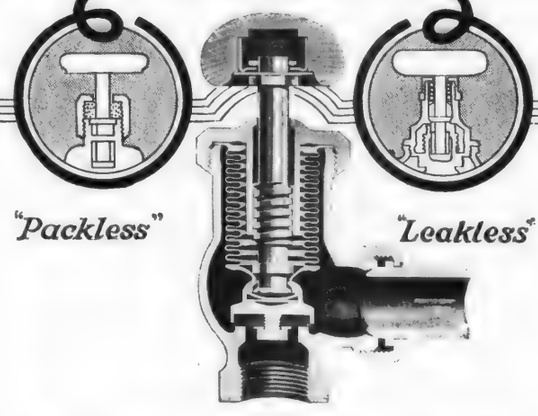
Detroit, Mich.

SYLPHON

The Valve without a Fault.

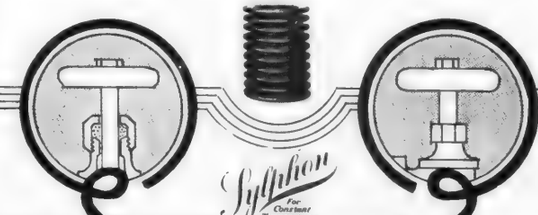
Composition Rings and Cotton wick packing are used in this so-called Packless Valve. The rings soon wear out causing the valve to leak.

In this so-called Packless Valve ground joints take the place of the ordinary cotton-wick packing. These soon wear down thru friction, making it necessary to renew them at intervals.



Years of bitter experience have taught reputable Architects and Contractors that it does not pay to use a cheap, inferior radiator valve that requires packing and adjustment every year or so. There are many so called "Packless" valves on the market. The majority of these have one or more of the disadvantages in construction as shown in the circles on this page. The SYLPHON PACKLESS radiator valve is the only valve that has NO PACKING—NO COMPOSITION DISCS, and NO METAL RINGS. There are no rotating or sliding parts exposed to steam or water and the valve CANNOT LEAK. The SYLPHON PACKLESS radiator valve permanently and positively insures the owner against all renewal expense. The valve is known as our "Government Pattern" and has been approved by the United States Government.

There's a Fulton agent near you—he'll be glad to explain and demonstrate. Send for pamphlet W.



In this type of valve cotton-wick packing is used which necessitates repacking every eight months or so.

Compare the beautiful rosewood, non-burning handle of the Sylphon Valve with this valve where exposed metal places one in danger of having the hand burned.

THE FULTON COMPANY

KNOXVILLE, TENN., U.S.A.

BRANCHES

New York, Hudson Terminal Bldg. 50 Church St. — Detroit, 1247 Washington Blvd. — Chicago, Wrigley Bldg. 400 Michigan Ave.

Representatives in all large Centers

The largest plant in the World devoted to the manufacture of thermostatic instruments

Webster

Systems of Steam Heating

The City of Baltimore may well be proud of its handsome recreation pier. It is not only highly artistic in appearance, but thoroughly practical in every way besides.

The equipment throughout is the most efficient and up-to-date that could be obtained, and with this standard in mind, the selection of a Webster System of Steam Heating was natural.

During each step of the planning and erection of the equipment the Webster engineers gave valuable suggestions and assistance that helped to secure an installation that would be ideally suited to the exact conditions of operation to be met, and this cooperation is tendered to operators of Webster equipment as well.

Webster Cooperation is at your service without obligation. Let us help you plan your next installation.

WARREN WEBSTER & COMPANY 135

CAMDEN, N. J.

Branches in Thirty-One Cities

Recreation Pier, Baltimore, Md. Theodore W. Pietsch, Architect; Riggs, Distler & Stringer, Inc., Heating Contractors.

—and who wants to waste steam at present prices of coal?

With coal at present high prices—and often hard to get at any price—it is far cheaper to put in enough Steam Traps Sarco to stop loss of steam through condensation than to stand the alternative of big waste at the coal pile.

Steam Trap Sarco puts the whole question of proper trapping vs. waste of coal on an entirely new basis—

It pays for itself at points where a big trap wouldn't be justified

You can put in *three* Sarcos for the cost of just *one* bucket or float trap—thus for the same expenditure saving *three times as much steam* and, therefore, *three times as much coal.*

Because it costs only one-third as much, a Sarco will quickly pay for itself at points where the expense of an old-style trap wouldn't be justified. And after paying for itself, every ounce of steam and every shovelful of coal it saves is all clear gain—for the upkeep is practically zero. No complicated mechanism to get out of order or require constant adjustment and attention. It has only one moving part.

Sarco is more dependable and efficient than old-style traps. It operates automatically—on a simple yet extremely sensitive and responsive system of liquid expansion and contraction. So positive in action that not an ounce of live steam can escape from one year's end to the other.

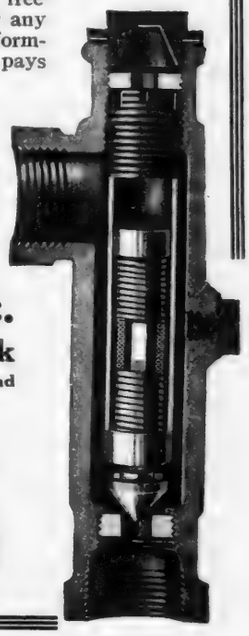
Drains off all condensate as fast as it forms—and immediately returns it to the hot well—while still *hot,* thus requiring less coal to convert it back into steam. And never any water (condensate) left in the pipes to freeze overnight or over Sunday.

30 Days' Trial

We are ready to let Sarco demonstrate its superiority and economy right in your own plant by sending you one on 30 days' free trial without a cent in advance. If for any reason you aren't satisfied with its performance; if it doesn't prove that it quickly pays for itself through the coal it saves, then you can return it and it won't cost you a cent.

Made in sizes ⅜ in. to 3 in. for any given pressure up to 200 lbs.

Booklet No. P-18 and full particulars about our free trial on request.



SARCO CO., Inc.

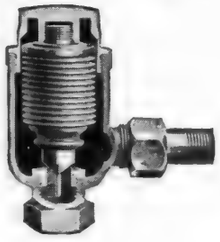
231 Broadway, New York

Buffalo Chicago Cleveland Detroit Philadelphia

STEAM TRAP SARCO

QUALITY SERVICE · QUALITY

Heating Specialties that Last

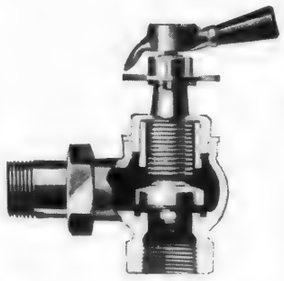


The B & B Line

In specifying the B. & B. Line of Heating Specialties for vacuum systems and Temperature Control Systems you are assured of getting QUALITY-SERVICE and a Heating Specialty that will last.

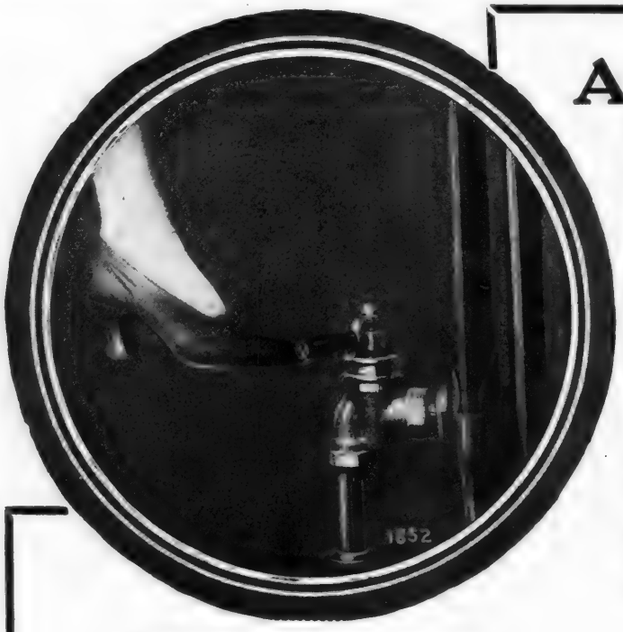
The B. & B. Multiflex Trap and B. & B. Multiflex Modulation Valve, as illustrated, are metal throughout and contain a B. & B. Multiflex Wonder Bellows. Note the simplicity in construction of the Multiflex Modulation Valve.

Literature sent upon request.



B. & B. Vacu-Vapor System
B. & B. Return Line System
B. & B. Air Line System
B. & B. Temperature Control System
B. & B. High Pressure Specialties

THE BISHOP & BABCOCK COMPANY
General Offices and Factories, CLEVELAND, OHIO.



No stooping—the slightest touch of the foot operates the valve

A Quarter Turn of the handle opens or closes the

GORTON
QUARTER-TURN
VALVE

It is the easiest operating valve in the world, and users will regulate heat in a room by opening and closing the radiators, saving steam.

With the old time valve requiring five or six turns of the wheel to open or close the valve users open the windows to cool a room, an immense waste of steam.

Wasted steam is wasted coal.

Equip your radiators with GORTON Valves and save money on your Coal Pile.

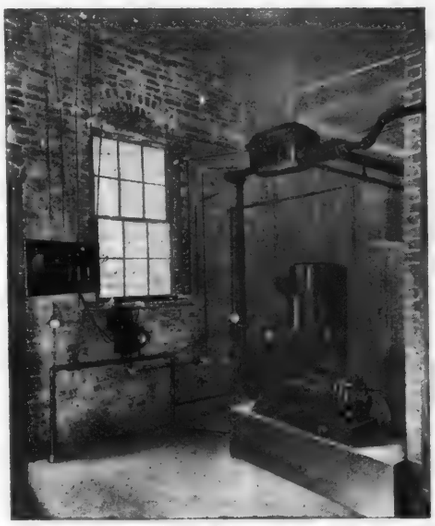
Write for Catalogue

Gorton & Lidgerwood Co.

Fisher Bldg., Chicago, Ill. 100 Liberty St., New York, N. Y.

See Sweet's Architectural Catalogue, Page 1757, for Specifications

KALAMAZOO—VACUUM—PUMP



Built under the following patents:
Sept. 4, 1917, May 24, 1921, Other patents pending

MANUFACTURED BY

CLARK ENGINE & BOILER CO.

KALAMAZOO, MICHIGAN

Let Us Have Your Specifications for a Finished Quotation Bulletin H-V-100

DESCRIPTION OF OPERATIONS

1st. The return from the heating system is connected to the pump through an ejector on the horizontal discharge line of pump. This ejector not only returns the condensation, but it withdraws the air and fixed gases from the heating system, producing a vacuum on all return lines. This vacuum is from five inches to fifteen inches, depending on the tightness of the heating system and the size of the unit installed.

2nd. All the condensation and air are delivered into the vertical storage tank and the air passes off through a pipe on the top of the tank to the atmosphere.

3rd. The tank storage furnishes a constant supply of water for the pump suction and no mechanism whatsoever is within the tank.

4th. The pump is a patented, extra high efficiency design, absolutely hydraulicly balanced so there is nothing to adjust or get out of order

5th. The pump has a capacity in excess of the two discharge lines, thus a constant pressure is maintained throughout.

6th. The vertical discharge line passes through a Float Control Box to the boiler. The float is controlled entirely by the level of the water in the boiler and operates a balanced piston valve within the box.

7th. When the boiler is full the float is at its upper extremity and all water is shut off and the electric current is broken to motor.

8th. When the water level lowers, the float gradually opens the valve and throws in the electric starting switch which starts the motor.

9th. This float control mechanism maintains a water level in the boiler automatically within two inches.

10th. Should the electric current for any reason be cut off, the float will lower less than an inch and in so doing will automatically turn on a supply of water from the city water system, and as the float rises this supply is automatically controlled, maintaining a low water level.

11th. This Float Box should be set so that the top machined surface of the lower half of the box is exactly level with the high water level of six inches over the boiler tubes.

12th. The Vacuum is also controlled by a Vacuum control switch and is usually set to cut in the motor and start the pump at two inches and cut out at eleven inches. This adjustment can be made in the field to suit the local conditions.

13th. The illustrations show one system of installation and many changes can be made to suit the boiler plant.

14th. We regularly build the Kalamazoo Vacuum Pump with vacuum control switch and with electric starter and gauges, all mounted on the tank, thus making it a complete self-contained unit.

15th. The motor is of ample size and of a standard make, proportioned to the special duties as required for each plant.

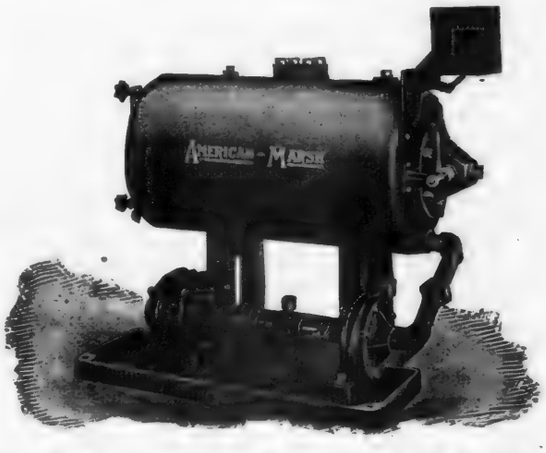
16th. The unit is mounted on a cast iron base plate which is machined on the bottom edge to insure ease in installing

17th. We build this unit for capacities from 3,000 to 200,000 feet of direct radiation and larger units will be made when required.

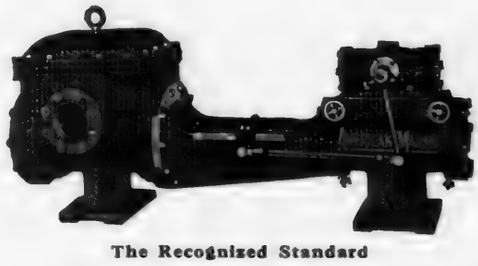
The Kalamazoo Vacuum Pump is the only thoroughly automatic unit of high efficiency known that maintains the water level in the boiler against all obstacles.

American-Marsh Pumps

for Heating Systems



For use in returning the condensation to the boiler on heating systems where the steam pressure is too low to operate a steam pump. Water is returned to the boiler in its hottest state. Equipped with an automatic float valve which is positive and reliable.



The Recognized Standard

American-Marsh Vacuum Pumps have been recommended and specified by a majority of the leading heating engineers and Contractors for over twenty years.

Made with only best of material and workmanship. Highest efficiency guaranteed.

Equipped with an improved steam valve which is especially adapted for vacuum service. American-Marsh Pumps are positive in action, possess a perfect governing element and will not hang up under all the varying conditions.

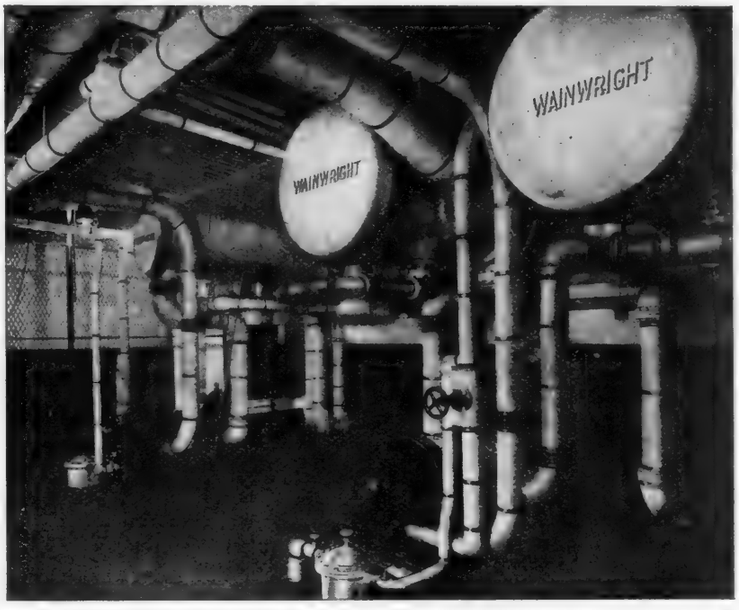
Ask for Bulletins Nos. 24 and 27

AMERICAN STEAM PUMP CO.

Battle Creek, Mich.

Our slogan: Simplex not Duplex. "To be simple is to be great"

HEATING SYSTEM HEATERS



ALBERGER PUMP & CONDENSER COMPANY

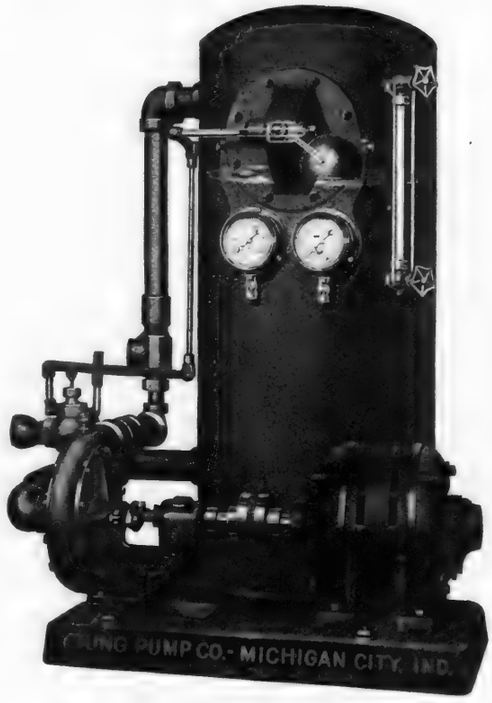
140 Cedar Street, New York

Boston **Chicago** **St. Louis** **Philadelphia**

Young Centrifugal Vacuum and Boiler Feed Outfits

Consists of a centrifugal pump with motor direct connected, tank, exhauster and balanced by-pass valve. The pump, motor and tank are mounted on a substantial cast iron base and the outfit completely assembled as shown in the cut, so that as received on the job it is only necessary to make pipe connections to the system and boiler, wiring connections to the motor, when it is ready for operation.

It is the simplest outfit made. There are no valves, springs or other parts that require adjustment, wear out or cause repair expense; not a feature more complicated or liable to cause trouble than the motor.



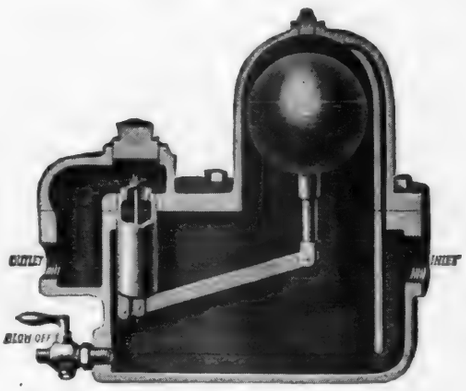
Made in six sizes to handle 4,000, 8,000, 16,000, 26,000, 40,000 or 65,000 sq. ft. of radiation; for continuous operation or automatic control, to meet any condition or pressure.

Complete information and prices upon application.

Write for descriptive pamphlet.

CHICAGO OFFICE

327 S. La Salle St. **Phone Harrison 5920**



Wright "Victor" Steam Trap is especially designed for low pressure service and will discharge the full capacity of the inlet pipe, without any head or pressure. Absolutely no pressure is required to operate this trap and it will give perfect results under vacuum and any working pressure up to twenty pounds. It will operate perfectly against any pressure less than the initial pressure on the inlet of the trap.

Wright "Victor" Lowers Steam Trap Costs

Cut down your steam trap costs by using the Wright "Victor" Trap for low pressure service.

The "Victor" Trap is especially adapted for continuously draining large volumes of condensation from low pressure apparatus, such as heating systems.

The great capacity of the "Victor" is obtained by having a valve nearly as large in area as the inlet pipe—a different and very distinctive feature of the "Victor" Trap.

Because the "Victor" has so much greater capacity than other traps, smaller sizes or, by grouping the drains, a smaller number of "Victor" Traps may be used with decided economy in first cost as well as in maintenance.

Extreme simplicity, great capacity and low cost are dominant features of the "Victor" Trap.

Write us about your trouble from condensation, improper heating, etc. Let our engineering department help you solve these problems.

WRIGHT-AUSTIN COMPANY
Detroit, Michigan

Branches: New York Boston Chicago

Representatives Everywhere

(24)

Buy a Gauge as You Hire a Man—for RELIABILITY.

When you hire a man for a responsible position you studys his face and his past carefully. It is imperative for you to know that he is *Reliable.*

No man in your plant is more important than the gauges that safeguard human life and your property. Hence it is just as vital that your gauges, too, be chosen for *Reliability.*

You eliminate the element of chance that attaches to gauges of "unknown" makes when your choice falls on

S&B Columbia Gauges

For a period of more than sixty years the reliability of S & B Columbia Gauges has been recognized the world over. Their unfallible precision has made the words "S & B Columbia Gauges" a synonym for dependability.

These remarkable gauges are made by skilled gauge makers, not by ordinary factory operatives. Each gauge is virtually an individual piece of workmanship, assembled and tested with the utmost care. The dials are hand calibrated, guaranteeing accuracy—only one of the many instances of painstaking attention to detail, which is responsible for their reliability.

S & B Columbia Gauges will give you dependable service covering a long period of years.

Some things you ought to know about gauges are told in our Catalog A-14.

Write for a copy—Today!

THE Schaeffer & Budenberg MFG. CO.

Makers of Columbia Recording Thermometers and Gauges with TIME PUNCH

Brooklyn, N. Y.

Chicago **Philadelphia**
Detroit **Pittsburgh**
Atlanta **San Francisco**
Los Angeles **Washington**
Toronto

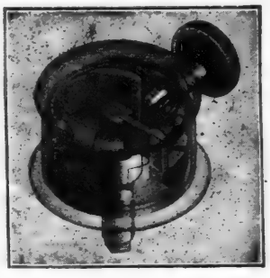
Are You Interested

IN A DAMPER REGULATOR THAT

Positively regulates the supply of hot or tempered air in heating and ventilating systems?

That shows the position of the damper in the pipe and is provided with lettered or numbered cover windows to correspond with the rooms to which the various pipes lead?

That effectively prevents any unauthorized person from tampering with the temperature control adjustment?



That may be placed on the wall of a room where the ventilating ducts are concealed within the wall and the damper connected to it by an extension of the square damper rod?

IF SO, THE

PERFECTO
Damper Regulator and Indicator

is the device you are looking for

Full particulars for the asking

THE SIXTH CITY SHEET METAL WORKS CO.
1830 St. Clair Ave., Cleveland, O.

"Exhaust Without Cost"

Air-o-matic Stationary Ventilator

People differ as to what they require of a ventilator. Some desire a stationary ventilator and for these the **AIR-O-MATIC** ventilator will exclude down-drafts, snow, and rain, while it is effectively exhausting all foul air. Other people require mechanical ventilation and for these there is no device superior to the **MACK** ventilator for heavy duty under conditions of light wind.

Mack Ejector Ventilator

Both of these ventilators are of sturdy, durable construction and both eliminate operating expense

Write us for full details

THE STARK SHEET METAL WORKS CO., 418 Second St., S. E., Canton, Ohio

ALLEN AIR-TURBINE VENTILATOR

Standard of Ventilating Efficiency

Wherever ventilation is desired—in factories, foundries, stores, schools, hotels, churches, theatres, residences, kitchens, bakeries, tanneries, barns, stables, garages, chimneys, air shafts, or wherever air circulation is required, Allen Air-Turbines *have proven the best, cheapest and most efficient* ventilating system known.

Many of America's largest architects, engineers and industrial concerns have adopted and endorse Allen Air-Turbine Ventilators.

Patented

Our air displacement is measurable and the figures given are guaranteed to be correct.

Diameter of Pipe	Air Displacement Cu. Ft. per Hour	
	Wind Velocity 4 Miles per Hour	Wind Velocity 8 Miles per Hour
8 Inches	17,300	21,600
10 "	26,500	32,500
12 "	38,600	46,200
15 "	54,000	69,000
18 "	85,200	102,100
20 "	105,100	125,600
24 "	149,000	185,000
30 "	225,000	272,000
48 "	360,000	473,000

CARRIES OFF
GASES
MOISTURE
STEAM
SMOKE
VAPOR
FOUL AIR
ODORS
HEAT
FUMES
DUST
DAMPNESS

Write for Detailed Literature

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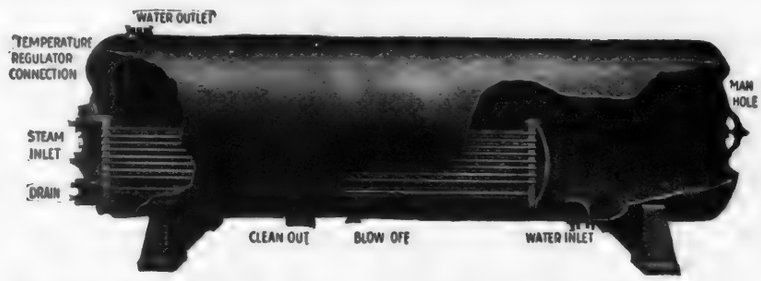

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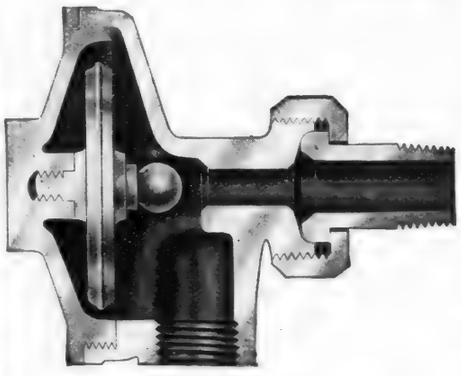

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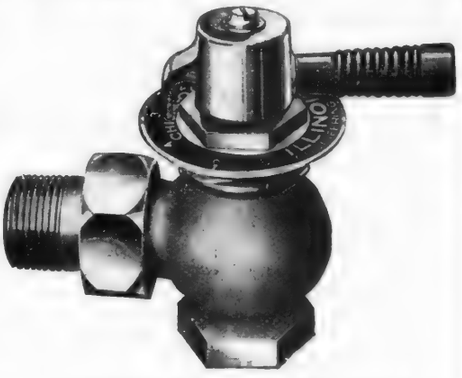

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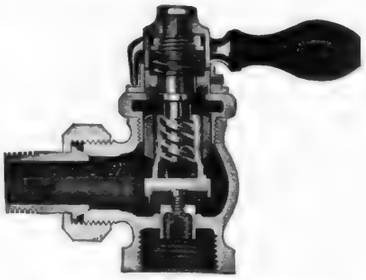

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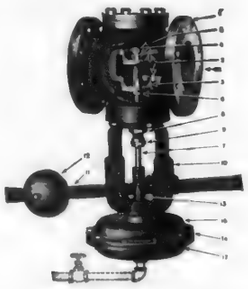

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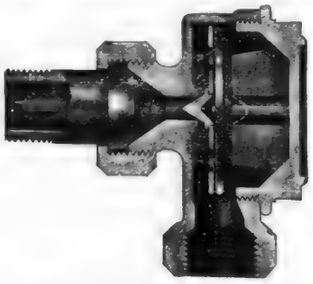

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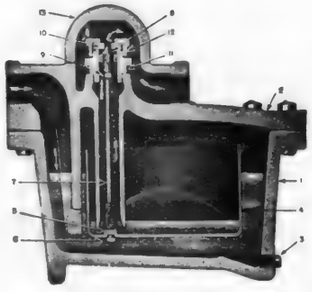

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The Heating and Ventilating Magazine

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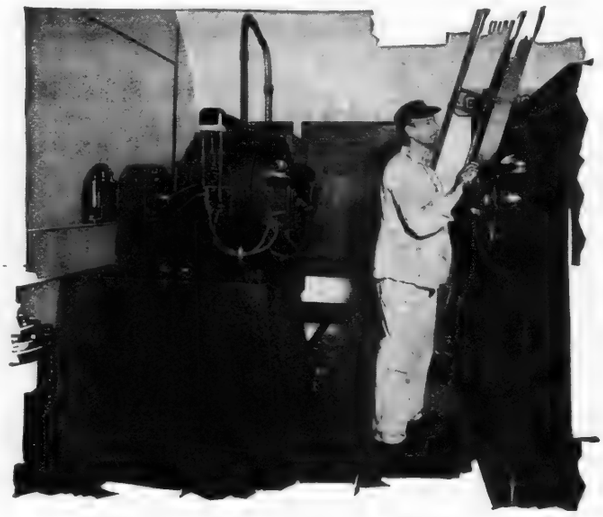

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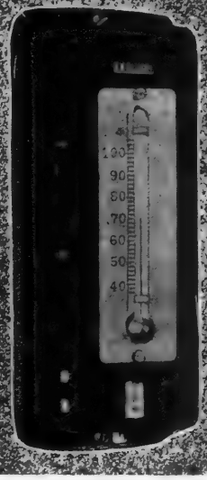

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A MONTHLY JOURNAL OF ENGINEERING PROGRESS

OCTOBER, 1921

RADIATION CALCULATION CHARTS

By D. N. CROSTHWAIT, JR. M. E.

THE calculation of radiation for buildings, where there are a large number of small or moderate-sized rooms to provide radiation for, such as office buildings, hotels, apartments, hospitals and institutions is usually accompanied by tedious routine calculations. The need for calculating the wall and glass surface repeatedly, in addition to reducing this to heat units and radiation, always results in the consumption of a large amount of time. Radiation is obtainable only in sizes which vary by increments of several feet and it is, in most instances, impossible to select a radiator of a size that exactly equals the size radiator calculated. Because of this a method of calculating radiation that is based on scientific methods and which is accurate within the limits by which the sizes of radiators vary, or the increment by which the sizes of radiators increase, should give results sufficiently accurate for use, especially so when its use eliminates the need for calculating wall and glass with a large saving in time.

To obtain maximum production in minimum time in manufacturing, the limits by which various dimensions of a product may vary from a given standard are fixed and any work passed is held within those limits. In the preparation of heating plans the application of quantity production methods, namely, methods which save time without sacrifice of accuracy of the required degree, are frequently very highly desirable, and on occasions may be almost indispensable.

The accompanying tables are designed to fill this need. When the basis upon which these tables are prepared is known it will be seen that by calculating them for other temperature differences, materials or air leakages or by multiplying by a factor their applicability is almost unlimited.

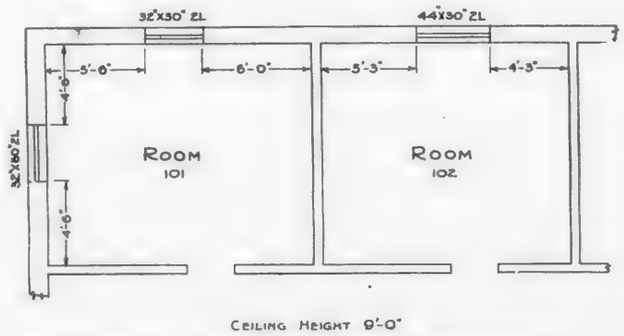

FIG. 1—PLAN OF ROOMS SHOWING DIMENSION OF EXPOSURE

HEATING DATA SHEET

ROOM No.	ROOM NAME	DIMENSIONS	CEILING HEIGHT	EXPOSURE	FLOOR AREA	CUBIC CONTENTS	LIN. FT WALL	WALL OVER WINDOWS	CEILING - WINDOW HEIGHT	NO. AND SIZE OF WINDOWS	RADIATION WALL	RADIATION WALL BY WINDOW	RADIATION WINDOWS	RADIATION NET	RADIATION EXPOSURE	HIGH CEILING	COLD FLOOR OR CEILING		TOTAL	USED
101	ROOM	12X14½	9	NE.	174	1566	20½	6	3½	2-32X30	20.79	2.20	15.18	38.17	9.54				47.71	
102	ROOM	12X13½	9	E.	162	1458	9½	4	3½	1-44X30	9.90	1.07	10.12	21.09	3.16				24.25	

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FIG. 2—SAMPLE OF DATA SHEET FOR RECORDING ROOM DIMENSIONS AND ESTIMATING REQUIRED RADIATION.

BASIS OF TABLES

To permit the use of the charts with greater confidence the basis upon which they were calculated is presented. The values comprising the charts were calculated by the B. T. U. method. The quantities of radiation in the "Glass Chart," Table I, are based upon a single thickness of glass, while the values or quantities of radiation in the table for wall are based upon a 12-in. thick brick wall, furred and plastered. The K factor for the glass is taken as 1.0 and the K factor for the wall as 0.26 B. T. U. per square foot per degree difference in temperature per hour. Expressed algebraically the formula for calculating the heat loss through the glass would be:

$Hg = GK\ (t_r - t_o)$, and the heat loss through the wall would be

$Hw = WK\ (t_r - t_o)$, where:

W = Area of wall in square feet.

G = area of glass surface in square feet, using masonry opening.

K = Coefficient of transmission in B. T. U. per square feet per hour per degree difference in temperature.

t_r = temperature of the room 70° F. in this case.

t_o = temperature of outside air 0° for calculating tables.

Hg = heat loss through glass.

Hw = heat loss through wall, both of the latter being in B. T. U. per hour.

Since no ordinary building is ever constructed air tight the heat loss due to infiltration of air must be provided for. If we designate heat loss resulting from the infiltration of air by H_a, we have

$$H_a = \frac{nC\ (t_r - t_o)}{55.2}$$

Where:

n = number of air changes per hour

C = cubic contents of room in cu. ft. t_r and t_o being the room and the outside temperatures as before, and 55.2 being the number of cubic feet of air 1 B. T. U. will raise 1° where 0.2415 is the specific heat of air at constant pressure and 0.0749 is the weight of a cubic foot of air at 70° F.

The heat loss from air infiltration is hard to determine definitely. Because of this it has been the practice of many engineers, as a result of observation, based upon comparison with many successful plants, to apply a factor which has been designated "n." The value of "n" has been found to vary from 1.5 to 2.5. (Values quoted from Allen and Walker's "Heating and Ventilating") and these tables have been calculated for ordinary tight construction and should not be used where the construction is not reasonably tight. These tables do not apply for fireproof buildings or other construction where the opportunity for heat loss by air infiltration is great.

The heat emission of the radiation has been taken at 250 B. T. U. per square foot per hour.

THE USE OF THE CHARTS

The window sizes are usually marked on or else given in a schedule of window sizes on the plans. The sizes are usually given in terms of the dimensions of the window panes and the number of lights, except in the case of windows with a number of small panes. If the construction is such that the radiation charts presented herewith are applicable, it will only be necessary to record the number and size of windows and take the radiation required to care for the heat loss through these windows directly from Table I. It will be noted that the size of windows and the window openings have both been given, so that, knowing either of them, it is only necessary to take the radiation directly from the charts. Exterior doors should be calculated as glass surface using the radiation indicated for a window having the same masonry opening as the door.

The radiation to compensate heat loss through the wall can be obtained by looking in the line corresponding to the ceiling height in the column headed with the number corresponding to the lineal or running feet of exposed wall.

TABLE I.

SQUARE FT. OF DIRECT CAST IRON STEAM RADIATION FOR HEAT LOSS THROUGH TWO PANE WINDOWS, INCLUDING SASH. ROOM TEMP. 70° FAHR. OUTSIDE TEMP. 0° F.

Width Glass Ins.	Width of Opening Ft. In.	Height Glass / Height Opening	18" 3'-6"	20" 3'-10"	22" 4'-2"	24" 4'-6"	26" 4'-10"	28" 5'-2"	30" 5'-6"	32" 5'-10"	34" 6'-2"	36" 6'-6"	38" 6'-10"	40" 7'-2"	42" 7'-6"	44" 7'-10"	46" 8'-2"	48" 8'-6"	50" 8'-10"	52" 9'-2"	54" 9'-6"
16	1-8	STANDARD SIZES OF TWO-LIGHT WINDOWS	2.69	2.94	3.22	3.45	3.68	3.96	4.23	4.46	4.74	4.97	5.24	5.47	5.75	5.98	6.26	6.53	6.76	6.99	7.27
18	1-10		2.94	3.22	3.49	3.77	4.09	4.37	4.65	4.92	5.20	5.47	5.75	6.03	6.30	6.58	6.90	7.18	7.45	7.73	8.00
20	2-0		3.22	3.54	3.82	4.14	4.46	4.74	5.06	5.38	5.66	5.98	6.26	6.58	6.90	7.18	7.50	7.82	8.14	8.42	8.74
22	2-2		3.40	3.82	4.14	4.46	4.83	5.15	5.47	5.80	6.16	6.44	6.76	7.13	7.45	7.82	8.14	8.46	8.83	9.11	9.48
24	2-4		3.77	4.09	4.46	4.83	5.20	5.52	5.89	6.26	6.62	6.95	7.31	7.68	8.00	8.37	8.74	9.11	9.48	9.84	10.21
26	2-6		3.99	4.42	4.78	5.15	5.52	5.89	6.30	6.72	7.08	7.45	7.87	8.23	8.60	8.97	9.38	9.75	10.12	10.58	10.95
28	2-8		4.28	4.69	5.11	5.52	5.93	6.35	6.76	7.13	7.54	7.96	8.37	8.79	9.20	9.57	10.03	10.39	10.81	11.22	11.64
30	2-10		4.60	4.97	5.43	5.89	6.30	6.72	7.18	7.59	8.05	8.46	8.88	9.34	9.75	10.21	10.67	11.04	11.50	11.96	12.42
32	3-0		4.83	5.29	5.75	6.21	6.67	7.13	7.59	8.05	8.51	8.97	9.43	9.89	10.35	10.81	11.27	11.73	12.19	12.65	13.11
34	3-2		5.06	5.57	6.07	6.58	7.04	7.54	8.00	8.51	8.97	9.48	9.94	10.40	10.90	11.41	11.87	12.42	12.88	13.34	13.80
36	3-4		5.38	5.89	6.39	6.90	7.41	7.91	8.42	8.97	9.43	9.94	10.49	10.95	11.50	12.01	12.51	13.02	13.52	14.03	14.58
38	3-6		5.61	6.16	6.72	7.27	7.77	8.28	8.83	9.38	9.94	10.44	11.04	11.50	12.05	12.60	13.16	13.71	14.26	14.77	15.27
40	3-8		5.89	6.44	7.04	7.59	8.14	8.69	9.25	9.84	10.39	10.95	11.55	12.05	12.60	13.20	13.80	14.35	14.90	15.46	16.05
42	3-10		6.16	6.76	7.36	7.96	8.51	9.11	9.66	10.30	10.86	11.45	12.05	12.60	13.16	13.80	14.40	14.99	15.55	16.10	16.74
44	4-0		6.44	7.04	7.68	8.28	8.88	9.52	10.12	10.76	11.32	11.96	12.56	13.16	13.80	14.40	14.99	15.64	16.24	16.79	17.48
46	4-2		6.72	7.36	8.00	8.65	9.25	9.89	10.58	11.22	11.78	12.47	13.06	13.71	14.35	14.99	15.64	16.33	16.93	17.57	18.22
48	4-4		6.99	7.64	8.28	8.97	9.61	10.30	10.95	11.64	12.28	12.93	13.57	14.26	14.90	15.64	16.28	16.93	17.62	18.22	18.86
50	4-6		7.22	7.91	8.60	9.34	10.03	10.67	11.41	12.05	12.74	13.43	14.12	14.81	15.50	16.19	16.88	17.57	18.26	18.95	19.59
52	4-8		7.49	8.23	8.92	9.66	10.35	11.04	11.78	12.51	13.20	13.94	14.63	15.36	16.10	16.79	17.48	18.22	18.95	19.64	20.33
54	4-10		7.77	8.51	9.25	10.03	10.76	11.50	12.24	12.97	13.71	14.44	15.13	15.92	16.65	17.39	18.17	18.86	19.64	20.38	21.16
56	5-0		8.05	8.88	9.57	10.35	11.13	11.89	12.65	13.34	14.17	14.95	15.64	16.47	17.25	18.31	18.77	19.55	20.33	21.16	21.85

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TABLE II.

SQUARE FT. OF DIRECT CAST IRON STEAM RADIATION FOR HEAT LOSS THRU WALL AREA OF VARIOUS DIMENSIONS. ROOM TEMP. 70° FAHR. OUTSIDE TEMP. 0°

HEIGHT OF CEILING	RUNNING FEET OF EXPOSED WALL WITHOUT REGARD TO WINDOW OPENINGS																		
	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
8	5.28	6.16	7.04	7.92	8.80	9.68	10.56	11.44	12.32	13.20	14.08	14.96	15.84	16.72	17.60	18.48	19.36	20.24	21.12
8½	5.61	6.60	7.48	8.36	9.35	10.34	11.22	12.10	13.09	13.97	14.96	15.95	16.83	17.82	18.70	19.58	20.57	21.45	22.44
9	5.94	6.93	7.92	8.91	9.90	10.89	11.88	12.87	13.86	14.85	15.84	16.83	17.82	18.81	19.80	20.79	21.78	22.77	23.76
9½	6.27	7.26	8.36	9.46	10.45	11.55	12.54	13.53	14.63	15.62	16.72	17.71	18.81	19.91	20.90	22.00	22.99	23.98	25.08
10	6.60	7.70	8.80	9.90	11.00	12.10	13.20	14.30	15.40	16.50	17.60	18.70	19.80	20.90	22.00	23.10	24.20	25.30	26.40
10½	6.93	8.03	9.24	10.34	11.55	12.65	13.86	14.96	16.17	17.27	18.48	19.58	20.79	21.89	23.10	24.20	25.41	26.62	27.72
11	7.26	8.47	9.68	10.89	12.10	13.31	14.52	15.73	16.94	18.15	19.36	20.57	21.78	22.99	24.20	25.41	26.62	27.83	29.04
11½	7.59	8.80	10.12	11.44	12.65	13.86	15.18	16.39	17.71	18.92	20.24	21.45	22.77	23.98	25.30	26.51	27.83	29.15	30.36
12	7.92	9.24	10.56	11.88	13.20	14.52	15.84	17.16	18.48	19.80	21.12	22.44	23.76	25.08	26.40	27.72	29.04	30.36	31.68
12½	8.25	9.57	11.00	12.32	13.75	15.07	16.50	17.82	19.25	20.57	22.00	23.32	24.75	26.18	27.50	28.82	30.25	31.57	33.00
13	8.58	10.01	11.44	12.87	14.30	15.73	17.16	18.59	19.91	21.45	22.88	24.31	25.74	27.17	28.60	30.03	31.46	32.89	34.32
14	9.24	10.78	12.32	13.56	15.40	16.94	18.48	20.02	21.56	23.10	24.64	26.18	27.72	29.26	30.80	32.34	33.88	35.42	36.96
CEILING HEIGHT	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
8	22.00	22.88	23.76	24.64	25.52	26.40	27.28	28.16	29.04	29.92	30.80	31.68	32.56	33.44	34.32	35.20	36.08	36.96	37.84
8½	23.32	24.31	25.30	26.18	27.06	28.05	28.93	29.92	30.80	31.79	32.78	33.66	34.65	35.53	36.52	37.40	38.39	39.27	40.26
9	24.75	25.74	26.73	27.72	28.71	29.70	30.69	31.68	32.67	33.66	34.65	35.64	36.63	37.62	38.61	39.60	40.59	41.58	42.57
9½	26.07	27.17	28.16	29.26	30.25	31.35	32.34	33.44	34.43	35.53	36.52	37.62	38.61	39.71	40.70	41.80	42.79	43.89	44.88
10	27.50	28.60	29.70	30.80	31.90	33.00	34.10	35.20	36.30	37.40	38.50	39.60	40.70	41.80	42.92	44.00	45.10	46.20	47.30
10½	28.82	30.03	31.13	32.34	33.55	34.65	35.75	36.96	38.06	39.27	40.37	41.58	42.68	43.89	44.99	46.20	47.30	48.51	49.61
11	30.25	31.46	32.67	33.88	35.09	36.30	37.51	38.72	39.93	41.14	42.35	43.56	44.77	45.98	47.19	48.40	49.61	50.82	52.03
11½	31.57	32.89	34.10	35.42	36.63	37.95	39.16	40.48	41.69	43.01	44.33	45.54	46.86	48.07	49.39	50.60	51.81	53.13	54.34
12	33.00	34.32	35.64	36.96	38.28	39.60	40.92	42.24	43.56	44.88	46.20	47.52	48.84	50.16	51.48	52.80	54.12	55.44	56.76
12½	34.32	35.75	37.07	38.50	39.82	41.25	42.57	44.00	45.32	46.75	48.07	49.50	50.82	52.25	53.57	55.00	56.32	57.75	59.07
13	35.75	37.18	38.61	40.04	41.47	42.90	44.33	45.76	47.19	48.62	50.05	51.48	52.91	54.34	55.77	57.20	58.63	60.06	61.49
14	38.50	40.04	41.58	43.12	44.66	46.20	47.74	49.28	50.82	52.36	53.90	55.44	56.98	58.52	60.06	61.60	63.14	64.68	66.22

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To calculate the radiation to compensate for the heat loss through the wall area above and below the windows, wall of dimensions equal to the ceiling height by half the width of windows may be used, or the same proportion of the radiation for a wall of given dimensions that the wall above and below the windows is, may be taken.

For exampe, ilf the wall above and below the windows of a room is 6 ft. by 3½ ft., one-third of the radiation required to care for a wall 6 ft. by 10 ft. may be used. This is approximate, but will be sufficiently accurate ordinarily. The radiation given for the windows is exact. The radiation to offset heat loss through wall above and below windows may be approximated by using radiation for a wall of dimensions equal to the ceiling height, with a width equal to half the total width of the windows. This latter approximation places the error on the side of safety.

FIGURING A TYPICAL ROOM FROM THE TABLES.

The use of the tables or charts will be more clear from an example. Assume the room shown in Fig. 1, reference being had to the "heating data sheet" shown in Fig. 2. For the purpose of permitting checking, space is provided on the data sheet for the number, name, dimensions and exposure of the room. Also, for the number and size of windows, the lineal or running feet of exposed wall, the width of wall above and below windows—to be inserted in column headed "Wall over windows"—and the difference between the ceiling height and the window height which is to be recorded in the column headed "ceiling-window height." The radiation for these is recorded in the corresponding columns under the heading "Radiation."

For example, the radiation to care for the heat loss through 2 two-pane windows 32 in. x. 30 in. is 15.18 sq. ft. The radiation to care for 20½ lineal feet of wall with ceiling height of 9 ft. is taken for wall 21 ft. long by 9 ft. high and equals 20.79 sq. ft. The radiation to compensate heat loss through a wall 3½ by 6 ft. is equal to one-third of the radiation required to deliver the amount of heat lost through a wall 3½ by 6 ft. and equals 2.20 sq. ft.

The exposure is a percentage of the net radiation which is the sum of the three quantities of radiation previously calculated. In the case of the room designated 101 on the heating data sheet it is 25%. The percentages usually allowed for exposure are: North, 35%, west 25%, east 15% and south 0%, unless the prevailing winter wind is from the south or southeast or southwest, in which case it is advisable to add 10% or 15% for southern exposure. Exposure in two directions is usually taken as the average of the percentages allowed for the single exposure.

For temperatures lower than 0° F., add 1.43% for each degree.

For other building materials, multiply the values selected from the proper table by a value or factor obtained by dividing the K factor, for the material of which the building is constructed, by 0.26.

A PROGRAM FOR SMOKE PREVENTION AND FUEL CONSERVATION

Details of a Proposed Block Plan of Heating, Together with Municipal Ownership and Operation of Gas Plants

BY E. VERNON HILL.

(Concluded from September Issue)

IN the September number we pointed out briefly some of the benefits that would be derived from the adoption of the block plan of heating. Let us assume, for the sake of argument, that the block system has been adopted and is now in operation. Chicago has an area of 192 sq. mi. Figuring 64 blocks to a square mile gives us 12,288 blocks. Deducting 15% for vacant property, parks, manufacturing districts, etc., we have a remainder of 10,432 blocks. Assuming 20 chimneys to the block, we have reduced the number of chimneys, potential smoke producers, from 208,640 to 10,432, or 95%. True, the 10,000 chimneys from the block service stations would be serving much larger heating plants than the original 208,000, but the better design and increased efficiency of the former make it reasonable to assume that the reduction in the amount of smoke would equal the reduction in the number of chimneys. Not only this, but the isolated heating plants in apartment buildings, residences, etc., often poorly designed and adapted for the fuel used have, it has been estimated, an average efficiency somewhere between 25 and 30%. We can safely assume that the heating plants in block service stations will have an efficiency of not less than 60%, thus making a saving of about 50% in the cost of fuel. Not only is this a very important item but the cost of delivery of coal and the nuisance resulting from the same is correspondingly reduced.

VALUES LOST IN BURNING COAL

This is a very material step toward the solution of our problem but it is by no means complete. So long as we continue to commit one of the greatest crimes against posterity, namely the burning of raw coal, we cannot lay any just claim to the proper solution of the smoke abatement and coal conservation problem.

THE HEATING AND VENTILATING MAGAZINE for September, 1919, contains an article on the fuel outlook in which the latent values contained in an average ton of raw coal are given as follows:

1500 lbs. of smokeless fuel	$ 5.00
10,000 cubic feet of gas at 90c per M.	9.00
22 lbs. of ammonium sulphate at 2.8c per lb.	.61
2½ gallons of benzol at 30c per gallon	.75
9 gallons of tar at 2.6c per gallon	.23
Total	$15.59

These figures are based on values in 1915 when bituminous coal at the mine sold for $1.13 per ton.

Kreisinger, Technical Paper No. 242, Bureau of Mines, gives figures as follows:

Cost of one ton of coal $7.00.

1 ton of coal produces .65 ton of coke	$ 6.00
5000 cubic feet of gas	5.00
3 gallons of motor oil	.75
9 gallons of tar	.25
25 lbs. ammonium sulphate	1.25
Total	$13.25

Taking the conservative figures of Kreisinger there is a waste of $6.25 per ton in destroyed bi-products in every ton of raw coal burned. As Chicago uses approximately 30,000,000 tons per year it is evident that we waste $195,000,000 annually from this inexcusable method of burning coal. The block plan of heating, therefore, while curing many of the ills due to our present method of heating does not touch this side of the problem.

MUNICIPAL GAS PLANTS ADVOCATED

The last step in our program of smoke prevention and coal conservation is the municipal ownership and operation of gas plants. The plants should be transformed and enlarged with the addition of bi-products ovens for the production of coke or semi-anthracite for distribution to our block service stations and for other domestic purposes, in sufficient quantities to meet the full demand. In order to do this the production of gas would be very much in excess of what is used at the present time and the price should be very materially reduced. The price of the coke or gas could be so altered as to encourage the use or conservation of either, and the process of manufacture could also be altered so as to increase or decrease either to a certain extent. In this way the entire supply of fuel becomes smokeless. Furthermore, we have recovered the valuable bi-products that go up the chimney when raw coal is burned.

It is true that there are many arguments advanced against the plan. The first is that municipal ownership and operation is unnecessary, that public utilities of this character are better managed by private capital. I believe the time has passed when this argument should be given serious consideration. True, in years gone by unbusinesslike management of some municipal activities, and other irregularities, have given an impression that municipal control is undesirable, but marked improvement in these lines is to be noted in recent years. The public takes a much greater interest in municipal affairs and at the present time municipally owned and operated utilities are rarely subjected to this criticism.

The City of Chicago is distributing 800,000,000 gal. of water per day at an average cost of approximately 6.1 cents per 1000 gal. This is the largest per capita supply of water in any city in the world and there is always a considerable surplus in the water fund. It would be hard to conceive of a private corporation giving this service. All the water supply tunnels in the city are now being constructed by city labor rather than by private contract, as it has been found that this method is cheaper and much more expeditious. The Municipal Tuberculosis Sanitarium has been operated for many years at a lower expense per capita per patient and a higher plane of efficiency than in any similar privately owned institution of which I am aware. Coal is a natural public commodity and is almost as essential as the water supply of the city. It does not lend itself naturally to competition and it is not a business on which a profit should be made. The gas and fuel plant suggested should be conducted as a public servict, with the view of supplying one of the prime necessities of modern civilization in the most efficient and economical manner.

Other objections to the plan can be traced to subsidiary

private corporation, to the coal dealers, boiler manufacturers, or those interested in some heating equipment used at the present time, who feel the adoption of the plan would materially restrict their field of distribution. But their objections will be overcome when the broader viewpoint is taken, when the entire subject is conceived as a necessary improvement in municipal welfare. The time is not far distant when public opinion will no longer countenance the inexcusable waste in our present methods and will demand a cheaper gas, a clean and efficient fuel, and a smokeless city.

DETERMINATION OF HOT WATER REQUIREMENTS

Essential Points to be Considered, with Data on Apartment Houses and Various Methods of Water-Temperature Control

BY WILLIAM WILCOX

PROFESSOR John R. Allen, speaking before the Eastern Pennsylvania Chapter, A. S. H. & V. E., gave the formula for writing a scientific treatise—to collect matter from all available sources published and unpublished, and arrange the accumulation to suit one's self. This left no provision for original contributions, though we know that Professor Allen's research developed as much original matter as could be contributed by any one engineer. The writer pleads guilty to the method of composing an article suggested by Professor Allen and would like to give credit to several engineers in the Navy Department, Department of Yards and Docks, Quartermasters' Department, the Supervising Architect's Office, and the Treasury Department, as well as to many engineers in private practice, for the material he has been able to gather.

In 1915 the writer had occasion to determine the proper storage capacity of a heater for a steam laundry operating about 15 power washers. The owner was insistent that a 10,000 gal. storage tank for hot water was desirable and a study was made of the operation of his plant at 5 minute intervals to show that during the longest periods of light draft, with the economical engine he contemplated, not over 500 gals. at 180° could be accumulated for storage. A 10,000-gal. storage tank, containing the equivalent of 500 gals. of hot water at 180°, would store 9500 gals. of cold water and be a 5% hot water tank, a 95% cold water tank, an absurdity demonstrated by this study.

USUAL METHOD OF FIGURING A LAUNDRY HEATER

The usual method of determining the desirable storage capacity of a laundry heater is by working upon the assumption that washers will use from 120 to 300 gals. per hour, according to size. By making a study of each washer at 5 minute intervals, covering a period of two hours, we were able to determine exactly the total amount of hot water required during each 5 minute interval regardless of whether or not a washer was completing a cycle in 20 minutes or in 90 minutes.

A similar study may apply to various fixtures in any building and this experience convinced the writer that it was desirable, in determining heater proportions for domestic service, to make a study based on the approximate number of gallons which would be used at each service and multiply by an estimated number of times the fixtures would be used each hour.

DATA ON HOT WATER FIXTURE CAPACITIES

About this time William A. Evans, of New York, tabulated data which he began collecting in 1912, to which reference was made in the *Journal* of the A. S. H. & V. E. for April, 1918, in connection with the report of a meeting of the New York Chapter of the society. These are shown in Table 1, which has become a standard reference sheet for architects and engineers and has been published in modified form by some manufacturers.

The data embodied in this table assisted the writer in developing hot water estimate forms as shown in Figs. 3A and 3B, and 4A and 4B. These estimates are based on the assumption that one service per shower or tub bath will require 20 gal. of water at 180° F., and not the amount originally printed in Table 1, which is undoubtedly too low. It is hoped that when a sufficient number of estimates have been made and verified in actual service some handy rule may be developed to determine a suitable per capita requirement, both as to storage and heating capacity.

FOUR ESSENTIAL ELEMENTS IN DETERMINING STORAGE.

The question of storage, however, as well as heating capacity, is so intimately related to the amount of steam available for heating purposes that no determination should be made

FIG. 1.

HOT WATER FIXTURE CAPACITIES FOR VARIOUS TYPES OF BUILDINGS FIGURED AT A FINAL TEMP OF 150°F

	GALS OF WATER PER HOUR PER FIXTURES												
	APART. HOUSE	CLUB	GYM.	HOSPITAL	HOTEL	APART. HOUSE	LAUNDRY	OFFICE BLDG.	PUBLIC BATH	PRIVATE RESID.	SCHOOL	YMCA BLDG.	
BASINS PRIVATE LAV.	3	3	3	3	3	3	3	3	3	3	3	3	
BASINS PUBLIC LAV.	5	8	10	8	10	15	10	8	15		15	10	
BATH TUBS	15	15	30	15	15	30			45	15		30	
DISH WASHERS	15	30		30	30	30				15	15	30	
FOOT BASINS	3	3	15	3	3	12				3	3	12	
KITCHEN SINK	10	20		20	20	20				10	10	20	
LDY STATIONARY TUBS	25	35		35	35		45			25		35	
LDY REVOLVING TUBS	75	75		100	150		75 TO 100		100	75		100	
POULTRY SINK	10	20		20	20					10	20	20	
SHOWERS	100	200	300	100	100	300			300	100	300	300	
SLOP SINK	20	20		20	30	20	10	15	15	15	20	20	
DISH WASHERS	180	NOTE — AT 180° CAPACITY 300 PEOPLE PER HOUR											
PER CENT OF TOTAL WATER FOR ALL FIXTURES LIKELY TO BE DRAWN AT ONCE	35	60	80	45	75	90	100	20	100	50	25	75	

APARTMENTS	ONE KITCHEN & ONE BATH					
NO. OF FAMILIES	UP TO 25	25-50	50-75	75-100	OVER 100	
GALS PER HOUR PER FAMILY	35	30	25	20	15	
SWIMMING POOLS	USUALLY FIGURE TO FILL POOL IN 24 HRS. ALSO FIGURE ON AERATION & ALL WATER IN POOL EVERY 24 HRS 30,000 GAL POOL CAP. FOR 100 PERSONS					

THE MANLOVE COIL PIPE CO. HARTFORD CONN. U.S.A. D-27

without considering the four elements,—peak requirements, hourly heating, storage capacity and steam available. Obviously where the peak requirements are well within the capacity of steam available, an instantaneous heater may be used and storage capacity would be unnecessary. In all cases where the hot water requirements add a steam load which at maximum constitutes a considerable percentage of the total steam load, storage of the proper amount to distribute steam draft throughout the day is highly desirable.

PREVENTING EXCESSIVE FLOW OF HOT WATER THROUGH SHOWER HEADS.

The selection of shower heads, the writer is confident, has not been given as much consideration as could be profitably be-

stowed upon them. A shower head used extensively in army and navy training stations contained, as an integral part of the head, a needle valve which could be adjusted until the pressure inside the shower head would be from 15 to 20 lbs. Another manufacturer of showers uses a stop cock in the hot water line to prevent excessive use of hot water. Many, however, by limiting the size of the holes in the shower, strive to cut down excessive flow which may not only waste water, but constitute a severe draft upon the steam plant.

The relation of size and number of holes, and water pressure, to the flow from fixture is shown in Table 2.

TABLE 2—SHOWER HEAD FLOW DATA.

Holes		Pressure Lbs.	Discharge, Gallons per Minute			Hot Water per Bath of Five Min., Gals.
No.	Size, In. Diam		100°	Hot, 180°	Cold, 40°	
79	0.052	15	6	2.57	3.43	12.85
..	.....	40	11	4.71	6.29	23.55
..	.....	75	22	9.42	12.58	47.10
36	0.462	15	3	1.29	1.72	6.45
..	.....	40	5½	2.36	3.15	11.80
..	.....	75	11	4.71	6.29	23.55

Evidently from this table it is important to secure as low a pressure in the shower head as will give the stinging due to high velocity which the user desires. If this velocity can be secured with a pressure of 15 lbs. in the shower head, about one-half as much water will be drawn as with a pressure of 40 lbs.

The superintendent of the Plumbing Department, City of Boston, has made an effort to secure this reduction in waste consumption by placing bushings in pipe lines running to shower heads. It has not been found practical to use a reducer directly at the shower head as the current of water was deflected so as not to supply some of the shower openings. When bushings are placed a little distance back of the line, away from the shower head, this objectionable feature has not been apparent.

Recently there was called to the writer's attention a shower head in combination with a heater. With steam supply line to the heater, coil and condensation flowing away from it, the cold water flowing through heater to the shower head becomes heated to the desired temperature by manual control of steam and cold water valves. By closing the cold water valve and vaporizing the water in the heater, a steam or vapor bath could be taken.

This device should have its application where occasional use of a few showers or frequent and continued use is expected, but for periodical peak drafts, followed by periods of light or no draft, it woud not seem so economical in service as a storage heater at a central plant. To supply the peak demands, big steam lines must be maintained with resulting heat losses. The construction is shown in Fig. 5.

ESTIMATES OF APARTMENT HOUSE REQUIREMENTS.

Estimates shown in Figs. 3A and 3B cover the same project, an apartment housing 130 inhabitants and with the stated number of bath tubs, kitchen taps, slop sinks, hand lavatories, dish washers, etc. The only difference between the two estimates consists in the assumed hourly output, storage capacity, and relating steam plant.

Referring to the estimate sheets we find a study covering each hour for each class of fixture. The peak draft upon one fixture may not necessarily coincide with the peak draft upon another fixture. The total hourly requirements are carried over into the column headed "total required gallons per hour" and obviously the number of gallons heated per hour, plus the number of gallons stored, must equal the demand for that period.

In Fig. 3A an hourly output of 400 gal. is assumed and a storage capacity of 305%,or 1220 gal. In all hotel and apartment house demands there is a characteristic hot water peak for early morning baths, a superimposed peak for breakfast requirements, a smaller peak at noon, a peak at evening meal, in some cases preceded by a bath demand, and the later evening draft which usually equals or exceeds the early morning peak.

ANALYSIS OF ESTIMATES.

Referring to the column in which are entered "total required gallons per hour" we find in the hour ending at 7 A. M., 800 gal., which exceeds the amount heated by 400 gal. (entered as minus 400 in column "hourly surplus gallons) which is drawn from storage, as noted in column "total surplus gallons," leaving 820 gal. surplus. The next hour, ending at 8 A. M,. the demand of 1000 gal. exceeds the amount heated by 600 and thus reduces the "total surplus" to 220 gal. The following hour's demand, exceeding the amount heated by 150 gal., again reduces the surplus to a net storage of 70 gal. Obviously, 70 gal. storage at the end of the morning peak affords a negligible factor of safety and storage capacity or hourly heating should be increased or a greater steam pressure be carried for this period, resulting in increased hourly output.

During the rest of the morning the hourly demand is less than the amount heated so that the hourly surplus is accumulated until at 1 P. M. we have a "total surplus" of 770 gal. reduced in the next hour by the midday peak to 670 gal. In early afternoon the storage is recovered to 100%, reduced by demand for evening meal, again recovers in part, to be again reduced by evening bath load.

ADVANTAGE OF PROVIDING LARGE STORAGE

Obviously any steam plant operates at greatest efficiency when the demand upon it is evenly sustained and widely-fluctuated demands are to be avoided. In this study, by providing relatively large storage, the maximum steam demand is low and well sustained, the average steam requirement over the period of estimate being 75% of the maximum, with two periods of maximum demand totalling 7 hours.

The relations of steam plant, hourly hot water requirements and net storage capacity are shown graphically in Fig. 3A. This is an actual study and while the apartment house is small, the method of determining hot water needs is as readily applied to big units.

Estimate 3B of the same apartment house, with hourly heating twice as great and steam demand double, is provided with storage capacity 51% of hourly heating,—liberal hourly heating capacity equals or exceeds the hourly demand except when morning and evening bath demand is superimposed upon the meal-time requirements. The chart, Fig. 3B, shows convincingly the steam demand fluctuating widely throughout the day, paralleling the water requirements, while the net storage of hot water is not reduced except at morning or evening peaks. A slightly greater hourly heating capacity would permit an instantaneous heater to be used and, in a plant provided with ample steam, an instantaneous heater would be the logical selection.

Estimates and charts (Figs. 4A and 4B) cover the same project, a Y. W. C. A., with dormitory, gymnasium and caféteria. Estimates and chart 4A are based on an hourly output of 600 gal., with storage capacity of 475%, or 2850 gal., with a relatively large storage and small hourly heating, the steam demand is sustained throughout the day to average 79% of maximum. The fluctuating demands are met by drafts on storage.

VARIOUS METHODS OF TEMPERATURE CONTROL

A treatise on this subject would not be reasonably complete without some reference to temperature control. Thermostatic regulators may be grouped in three principal classes: Those relying upon the expansion and contraction of metals operating through a series of levers to open or close the steam inlet valve; those relying upon the expansion and contraction of a metal

APARTMENT HOUSE
130 PEOPLE
93 APARTMENTS

HOT WATER ESTIMATE SHEET #3A

These ratings are based on hot water at 180° F

	Bath tubs 20 gal. per bath	Kitchen sinks 5 gal. per hour	Slop sink taps 10 gal. per hour	Hand lavatories 2 gal. per service		Pounds of Steam used per hour	Total required Cubic feet per hour	Gallons stored per hour	Hourly surplus Gallons	Total surplus Gallons
	93	11	8	99						
1 A.M.										
2 Maximum hourly steam required=480 lbs.=16 HP=1920 radiation;										
3 full steam load sustained 10 hours out of 18 covered by estimate										
4 =average steam load 360 lbs. per hour=75% of max. load;										
5 4 hours continuous load, 3 hours continuous load.										
6 Storage capacity 305% of hourly heating.										
6	200	100		50		420	350	400	50	1220
7	600	100		100		480	800	400	− 400	820
8	600	100	50	100	150	480	1000	400	− 600	220
9	200		100	50	200	480	550	400	− 150	70
10			100			120	100	400	300	370
11		100	100			240	200	400	200	570
12 M		100	100	100		360	300	400	100	670
1 P M		100		100	100	360	300	400	100	770
2		100	100	100	200	480	500	400	− 100	670
3			100			120	100	400	300	970
4			100			120	100	400	300	1220
5	200	100	100			480	400	400	000	1220
6	600	100	100	100		480	900	400	− 500	720
7	200	100		100	100	480	500	400	− 100	620
8		100		100	300	480	500	400	− 100	520
9					100	120	100	400	400	920
10	400					480	400	400	000	920
11	600					480	600	400	− 200	720
12 Steam Pressure										
Steam available from Heating System.										
Water Pressure										

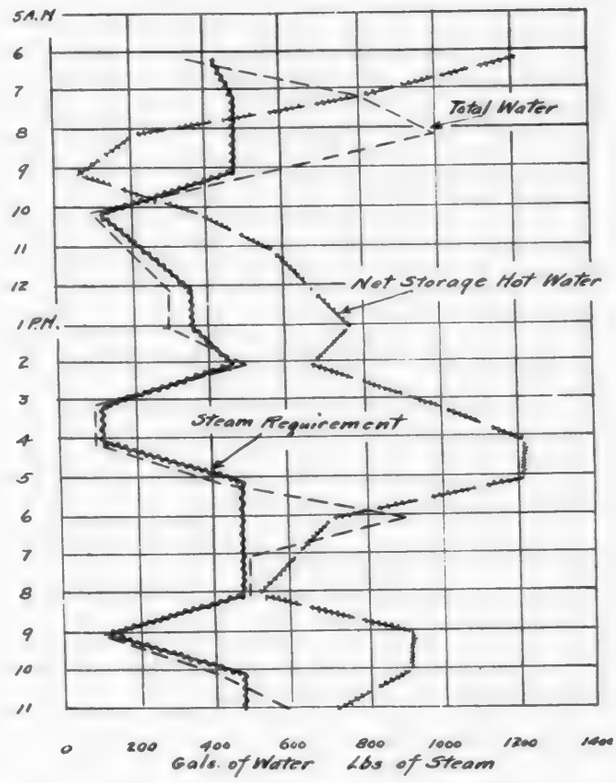


TABLE 3 A AND CHART 3 A—EFFICIENT HOT WATER SERVICE IN AN APARTMENT BUILDING.

Building Contains 93 Apartments, 130 People; Small Peak Steam Requirement, Evenly Sustained; Storage Is Adequate for Peaks and Equals 305% of Hourly Heating Load.

APARTMENT HOUSE
130 PEOPLE
93 APARTMENTS

HOT WATER ESTIMATE SHEET #3B

These ratings are based on hot water at 180° F

	Bath tubs 20 gal. per bath	Kitchen sinks 5 gal. per hour	Slop sink taps 10 gal. per hour	Hand lavatories 2 gal. per service		Pounds of Steam used per hour	Total required Cubic feet per hour	Gallons stored per hour	Hourly surplus Gallons	Total surplus Gallons
	93	11	8	99						
1 A.M										
2 Maximum hourly steam required=960 lbs.=32 HP=3840 radiation;										
3 full steam load sustained 3 hours out of 18 covered by estimate										
4 =average load of 491 lbs. steam per hour=51% of max. load										
5 Storage capacity=51% of hourly heating.										
6	200	100		50		420	350	800	450	420
7	600	100		100		960	800	800	0	420
8	600	100	50	100	150	960	900	800	− 100	320
9	200		100	50	200	660	550	800	250	420
10			100			120	100	800	700	420
11		100	100			240	200	800	600	420
12 M		100	100	100		360	300	800	500	420
1 P M		100		100	100	360	300	800	500	420
2		100	100	100	200	600	500	800	300	420
3			100			120	100	800	700	420
4			100			120	100	800	700	420
5	200	100	100			480	400	800	400	420
6	600	100	100	100		960	900	800	− 100	320
7	200	100		100	100	600	500	800	300	420
8		100		100	300	600	500	800	300	420
9					100	120	100	800	700	420
10	400					480	400	800	400	420
11	600					720	600	800	200	420
12 Steam Pressure										
Steam available from Heating System										
Water Pressure										

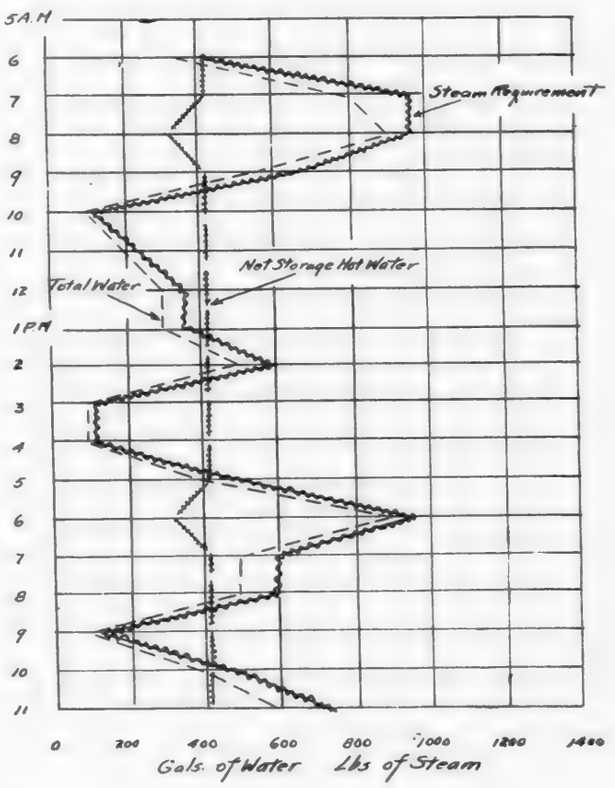


TABLE 3 B AND CHART 3 B—INEFFICIENT HOT WATER SERVICE IN THE SAME APARTMENT BUILDING.

Big Peak Steam Requirement, Not Sustained; Storage Is Reduced but Little for Peak Drafts and Equals 51% of Hourly Heating Load.

Y.W.C.A. **HOT WATER ESTIMATE SHEET** 42

These ratings are based on hot water at 180° F

	Showers 17	Bath tubs 17	Kitchen	Slop sinks	Lavatories							
1 A M												
2	Maximum hourly steam required=720 lbs.=24 H.P.=2880 radiation;											
3	full steam load sustained 10 hours out of 18 covered by estimate											
4	=average load 570 lbs. Steam per hour=79% of max. load;											
5	maximum load sustained for 7 hours continuously.											
	Storage capacity=475% of hourly heating.											
6	100	100	50		30	50		396	330	600	270	2850
7	200	200	50		100	50		720	600	600	0	2850
8	300	300	100	50	200	50	100	720	1100	600	- 500	2350
9	100	100	100	50	100	50	100	720	600	600	0	2350
10		40	50	50			100	128	240	600	360	2760
11			50	50				120	100	600	500	2850
12 M			100	50	50			240	200	600	400	2850
1 P M			100		100		100	360	300	600	300	2850
2			100	50	50		100	360	300	600	300	2850
3			50	50			100	240	200	600	400	2850
4	800		50	50				720	900	600	- 300	2550
5	1000	40	50	50				720	1140	600	- 540	2010
6	600	100	100	50	50			720	900	600	- 300	1710
7	400	100	100		100		50	720	750	600	- 250	1460
8	600	100	100		50	50	100	720	1000	600	- 400	1060
9	1000	200	50			100	100	720	1450	600	- 850	210
10	400	200				100	50	720	750	600	- 150	60
11	100	100						240	200	600	400	460

12 Steam Pressure 0 to 2 Lbs.

Steam available from Heating System with Vacuum Pump

Water Pressure

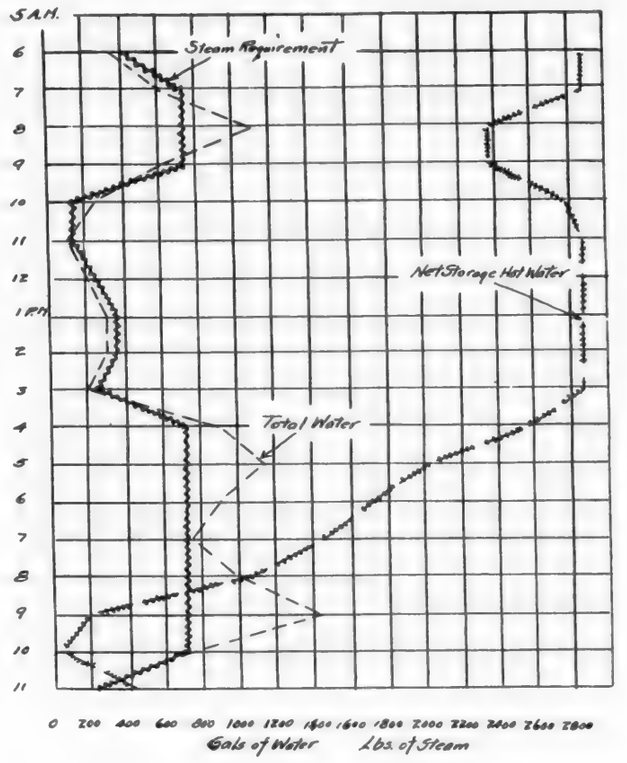


TABLE 4 A AND CHART 4 A—EFFICIENT HOT WATER SERVICE IN A Y. W. C. A. BUILDING.

Small Steam Requirement, Evenly Sustained; Storage is Adequate for Peaks and Equals 475% of Hourly Heating Load.

Y.W.C.A. **HOT WATER ESTIMATE SHEET** 43

These ratings are based on hot water at 180° F

	Showers 17	Bath tubs 17	Kitchen	Slop sinks	Lavatories							
1 A M												
2	Maximum hourly steam required=1200 lbs.=40 H.P.=4800 radiation,											
3	full steam load sustained 4 hours out of 18 covered by estimate											
4	=average load 695 lbs. steam per hour=58% of maximum load;											
5	maximum load sustained for 2 hours continuously heating											
	Storage capacity=52½% of hourly heating.											
6	100	100	50		30	50		396	330	1000	670	525
7	200	200	50		100	50		720	600	1000	400	525
8	300	300	100	50	200	50	100	1200	1100	1000	100	425
9	100	100	100	50	100	50	100	720	600	1000	400	525
10		40	50	50			100	230	190	1000	810	525
11			50	50				120	100	1000	900	525
12 M			100	50	50			240	200	1000	800	525
1 P M			100		100		100	360	300	1000	700	525
2			100	50	50		100	360	300	1000	700	525
3			50	50			100	240	200	1000	800	525
4	800		50	50				1080	900	1000	100	525
5	1000	40	50	50	50			1200	1150	1000	150	375
6	600	100	100	50	100			1140	950	1000	50	425
7	400	100	100		50		50	960	800	1000	200	525
8	600	100	100			50	100	1200	1000	1000	000	525
9	1000	200	50			100	100	1200	1400	1000	400	125
10	400	200				100	50	900	750	1000	250	575
11	100	100						240	200	1000	800	525

12 Steam Pressure 0 to 2 lbs.

Steam available from Heating System with Vacuum Pump

Water Pressure

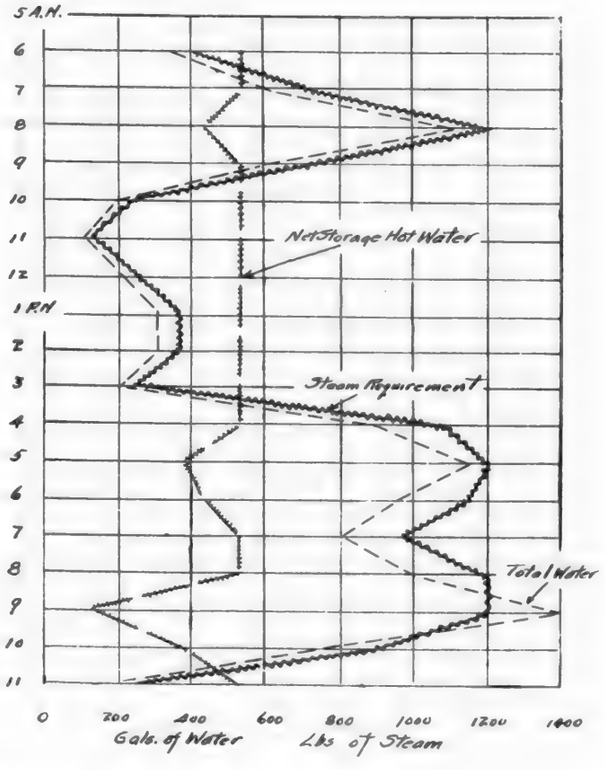


TABLE 4 B AND CHART 4 B—INEFFICIENT HOT WATER SERVICE IN A Y. W. C. A. BUILDING.

Big Peak Steam Requirement, Not Sustained; Storage Is Not Reduced Materially for Peak Drafts and Equals 52½% of Hourly Heating Load.

thermostat which permits the escape of water under pressure designed to open or close steam inlet valve through action upon a diaphragm; and the class of thermostatic control valve which is self-contained, the thermostatic element being hollow and carrying a liquid which vaporizes at the proper temperature, expanding with the heat to operate a diaphragm or bellows which opens and closes steam inlet valve. All of these regulators have their particular advocates, but the tendency among architects and engineers seems to favor the self-contained regulator.

The location of the thermostatic element is quite essential as regards the satisfactory and efficient performance of the hot water system. In Fig. 6 the thermostatic element is shown in a

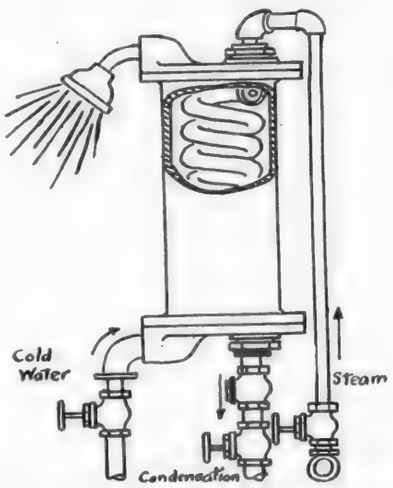


FIG. 5—COMBINATION OF SHOWER HEAD AND SERVICE HEATER.

tee at the hot water outlet. This is the correct location when most of the water is heated with exhaust or low-pressure steam in the lower heating unit and it is desired to have the upper heating unit using live high-pressure steam, act in much the same relation as would an instantaneous booster heater. Obviously, the thermostatic valve will not open until all the water at the desired temperature stored in the shell is discharged. This would result in short periods of heavy draft upon the steam plant.

When it is desired to distribute the demand for high-pressure steam over a considerable period and avoid these peaks, the thermostatic element should be inserted in the shell so as to extend into the upper portion of the heater, the bottom being in about the same horizontal plane as the lower portion of the heating unit to be controlled.

A more even demand upon the steam plant will occur if the thermostatic element is placed in the head of the heater, expending parallel with the tubes and in the same horizontal plane as the lower portion of the heating unit to be controlled. Where a storage heater is used, utilizing live steam in one heating unit only, the heating element to secure the greatest economy of operation should be located in the same horizontal plane as the heating unit which it controls.

A TYPICAL CASE WHERE LOCATION OF THERMOSTATIC VALVE DETERMINED CAPACITY

The writer has in mind a hotel installation in which the heating element was placed at the upper fifth of water storage; this

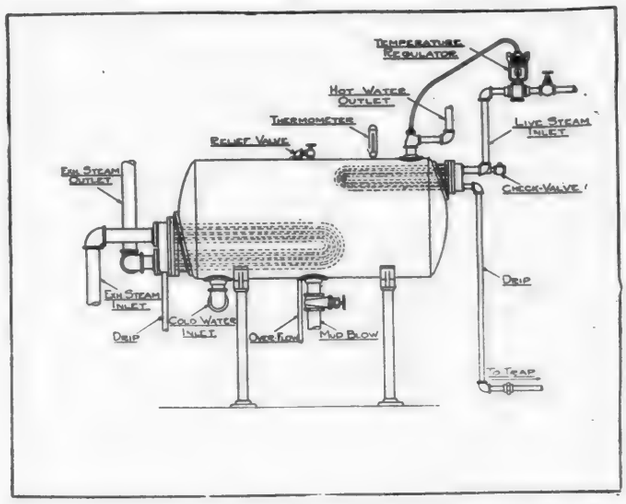


FIG. 6—STORAGE HEATER SHOWING THERMOSTAT AT HOT WATER OUTLET.

shut off the live steam supply to heating unit low in shell when the contents of the heater became 20% hot and 80% relatively cold. When the heater was found inadequate, another heater was added, with the thermostat located at the same point, and still the supply of hot water was inadequate at times. Finally a third heater was added, with the thermostatic element at about the same relative location. Hot water supply being still unsatisfactory, a consulting engineer was called in and he discussed the question with the writer regarding the addition of a fourth heater. It was decided, before taking action, that new tappings be made in the head of the heater at a point as near as possible to the horizontal plane coincident with the center axis of the heating unit, thus changing the hot water system from a 20% hot water and 80% relatively cold water system to one with relations of hot and cold water reversed. This change was made and the hotel derived an abundant supply of hot water, with a reduced peak consumption of steam.

QUESTION OF STEAM VELOCITY THROUGH HEATER.

Another element which has not been given the consideration which it deserves is the question of steam velocity. It is generally considered desirable to have a high velocity through the automatic temperature regulator (about 10,000 to 12,000 ft. per minute), but it is equally important to have the proper velocity of steam at the heater inlet. Data on this subject are in preparation and will no doubt be found valuable to engineers interested in this subject.

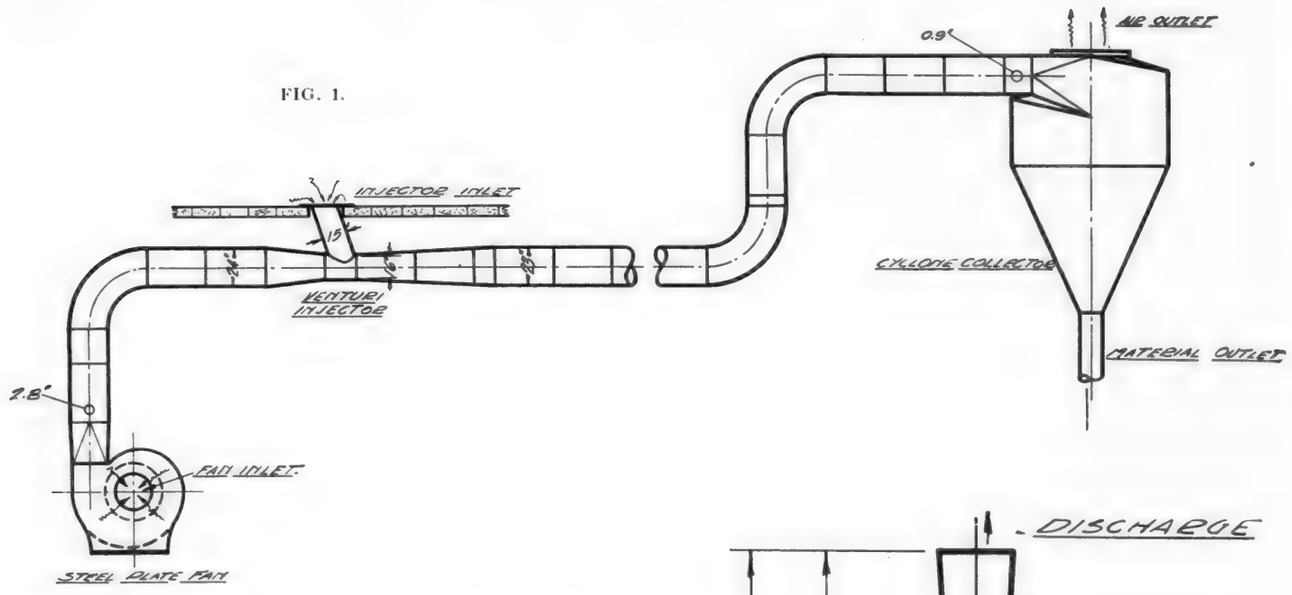
PNEUMATIC INJECTORS FOR BLOWER AND MECHANICAL DRAFT WORK

Possibilities in the Application of this Principle to Low-Pressure Air-Handling Systems

BY JOHN L. ALDEN.

ALTHOUGH the pneumatic injector has the possibility of wide application to low pressure air-handling systems, but little use has been made in this country, of its valuable characteristics. Abroad, it has met with much favor, both in connection with blower systems, and with mechanical draft installations. One of the best known induced draft systems on the continent is the "Prat air jet chimney ventilator," or évasé stack. This has been described in a number of English and American engineering periodicals in the past ten years, and the practical features of the installation have been covered quite completely. A not less important application is in the field of pneumatic conveying and dust collecting wherein it is desired to

FIG. 1.



handle abrasive material or corrosive fumes without subjecting the fan or pressure blower to their destructive influences. In the same manner, it is often of great importance to minimize the fire hazard in textile mills by introducing the fibrous material into the blast pipes of the conveying system in such a way that it is not passed through the fan. Installations of this nature are discussed at length in various bulletins put out by some of the mutual fire insurance companies.

Fig. 1 shows a simple injector system which well illustrates the principle on which all such systems operate. A centrifugal fan with an open inlet, blows air through a piping system into a cyclone dust collector. In this discharge pipe is a Venturi tube into the throat of which is connected a suitable inlet pipe. When the Venturi is properly proportioned to suit the volume of air and the resistance, a suction will be produced at the throat, and air will be drawn in through the injector inlet. However, if the throat does not bear the proper relation to the pipe diameter,

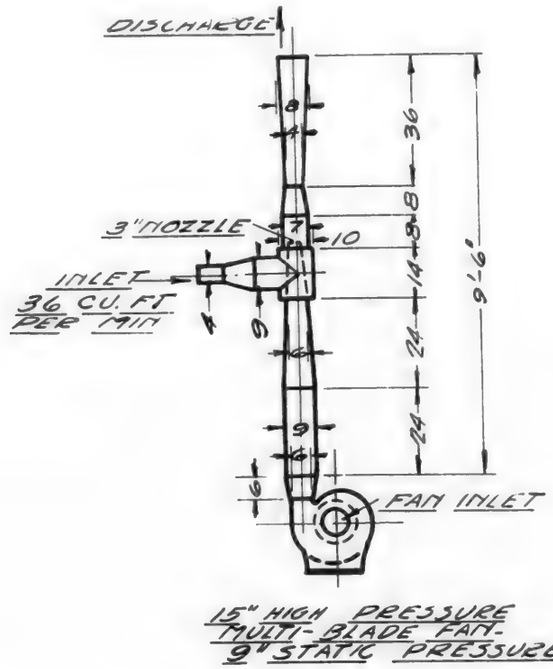


FIG. 3—INJECTOR SYSTEM FOR DRAWING MEASURED GAS SAMPLES THROUGH CHEMICAL APPARATUS.

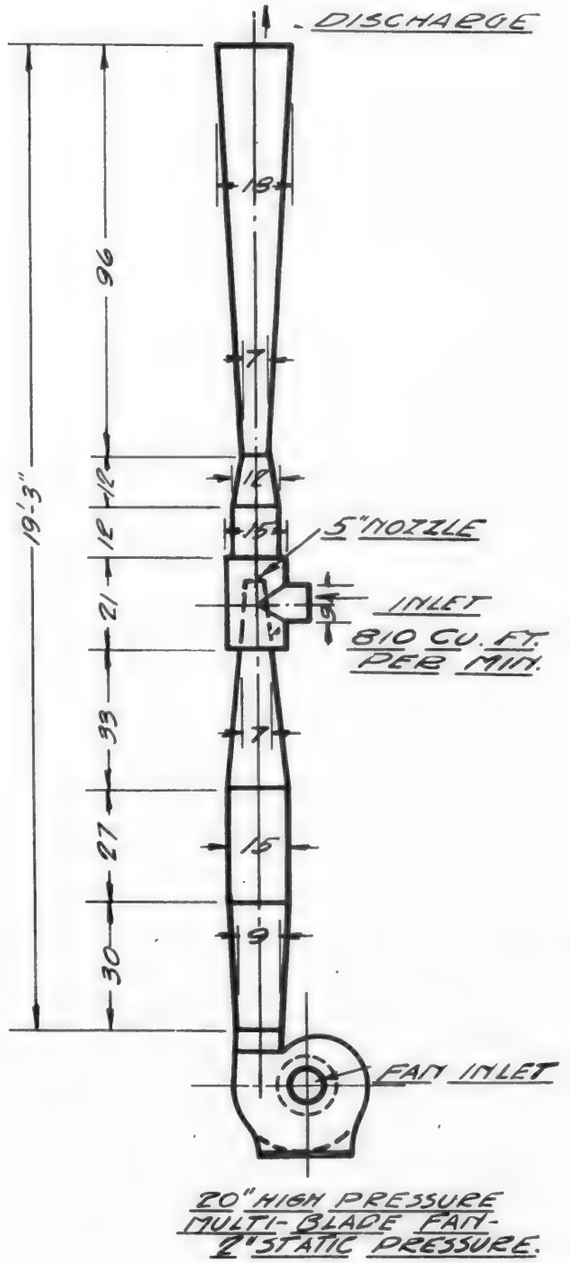


FIG. 2—INJECTOR SYSTEM FOR REMOVING NOXIOUS FUMES FROM SHELL-FILLING MACHINE.

a back pressure instead of a partial vacuum will be created at the Venturi throat and air will be blown out of the inlet. Such a condition, of course, results in the failure of the system, since it is then impossible to introduce material into the pipe.

BEST ADAPTED FOR HANDING GRANULAR MATERIALS.

Granular materials are easily handled with this system. An enormous volume of material can be fed into the inlet with entire freedom from trouble with clogged pipes. Long fibre, such as hemp, jute, burlap or yarn waste, or any stringy material which is matted together heavily before feeding is hard to handle in such a system. The slug of fibre entering the throat offers resistance to the high velocity air current for the instant of time required for it to gain speed. This momentary obstruction is sufficient ot cause a puff of dusty air from the injector inlet The duration of the blast, a fraction of a second, is the time required for the slug to pass out of the Venturi cone.

During the war a small gas-shell filling plant was built by the American troops in France. A well-known British firm designed and installed two exhaust systems to handle poison gas fumes at his plant. One of these was to remove noxious fumes from the shell filling machine, discharging them at high velocity well above the breathing zone. The other and smaller system was for the purpose of drawing measured gas samples, mixed with varying amounts of air, through chemical apparatus for determining concentrations, lethal doses, etc. The piping of both systems, including the injectors, was of chemical stoneware so as to be highly resistant to corrosion. High-pressure multi-blade fans were used. The larger one had a blast wheel diameter of 20 in. but operated at a static pressure of 2 in. of water. The smaller fan had to induce a sufficiently high suction to overcome the resistance of small and crooked tubes, and therefore operated at a static pressure of 9 in. of water, using a blast wheel 15 in. in diameter. Both fans had steel-plate cases and were equipped with self-aligning ball bearings.

The fan and injector of the larger system are shown in Fig. 2. Fig. 3 shows the induction system of the smaller plant. The dimensions of both plants were taken at the time of installation in 1918. As is clearly shown, the fan draws fresh air from the atmosphere, discharging it vertically through the nozzle and expanding cone. The gas-polluted current of induced air is drawn through the inlet midway up the stack into the annular chamber surrounding the nozzle and there mixed with the fan blast. When handling gases only, it is preferable to employ the annular chamber shown in Figs. 2 and 3, thereby permitting the induced current to flow in on all sides of the central jet. In conveying work, however, any unnecessary air introduced with the material is a detriment, as it requires additional power to move, and performs no useful work. When the throat of the Venturi is properly proportioned, a very large inlet may be cut in it, as in Fig. 1, without seriously affecting either the volume of air or the pressure loss through the injector.

THE EXTENT OF THE EXPERIMENTAL ERROR INVOLVED IN THE FACTORING OF KATATHERMOMETER*

By LEONARD GREENBURG.

Assistant Sanitary Engineer, U. S. P. H. S.

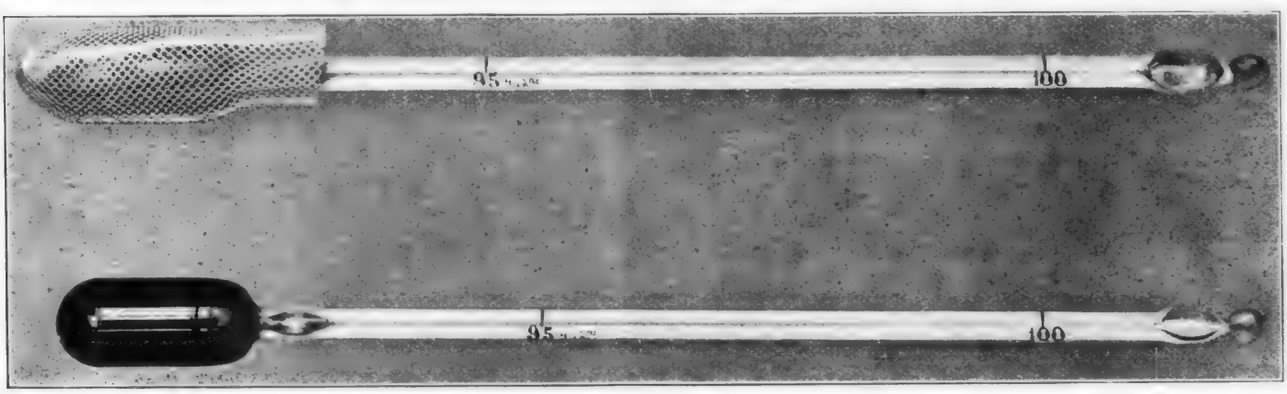
IN conducting certain work with the kata-thermometer it was found necessary from time to time to determine the factors of various of these instruments; the reason for this being that only unfactoried instruments of American make were obtainable.

The method used by us in factoring kata-thermometers was exactly the same as described by Leonard Hill.[1] An air calorimeter was used; this consisted of a cylindrical galvanized-iron pail 14-in. inside diameter and 14-in. deep. The pail was equipped with a tight-fitting cover in which three holes were made, one hole in the center and the other two 3 in on either side along a diameter. A collar consisting of a short piece (½-in.) of metal tubing was soldered into each hole so that when a stopper was inserted there was no air leakage about the orifice. In the center hole an ordinary thermometer reading directly to 0.2° C. was inserted, while in the hole on its left was placed a kata-thermometer of previously determined factor to serve as a comparison. In the right orifice was inserted the kata to be factored.

In view of the importance of a clear knowledge of the reliability of the factoring procedure, it is our desire to here record the observations we have made on kata No. 52 (made by J. Hicks, London, E.) and on kata No. L (our number), (supplied by the Siebe Gorman Company, Chicago, Ill.)

The method used in making the observations is that des-

* Investigation conducted in the laboratories of the Department of Public Health of the Yale University School of Medicine, New Haven, Conn.



TYPE OF KATA-THERMOMETER USED IN INVESTIGATION

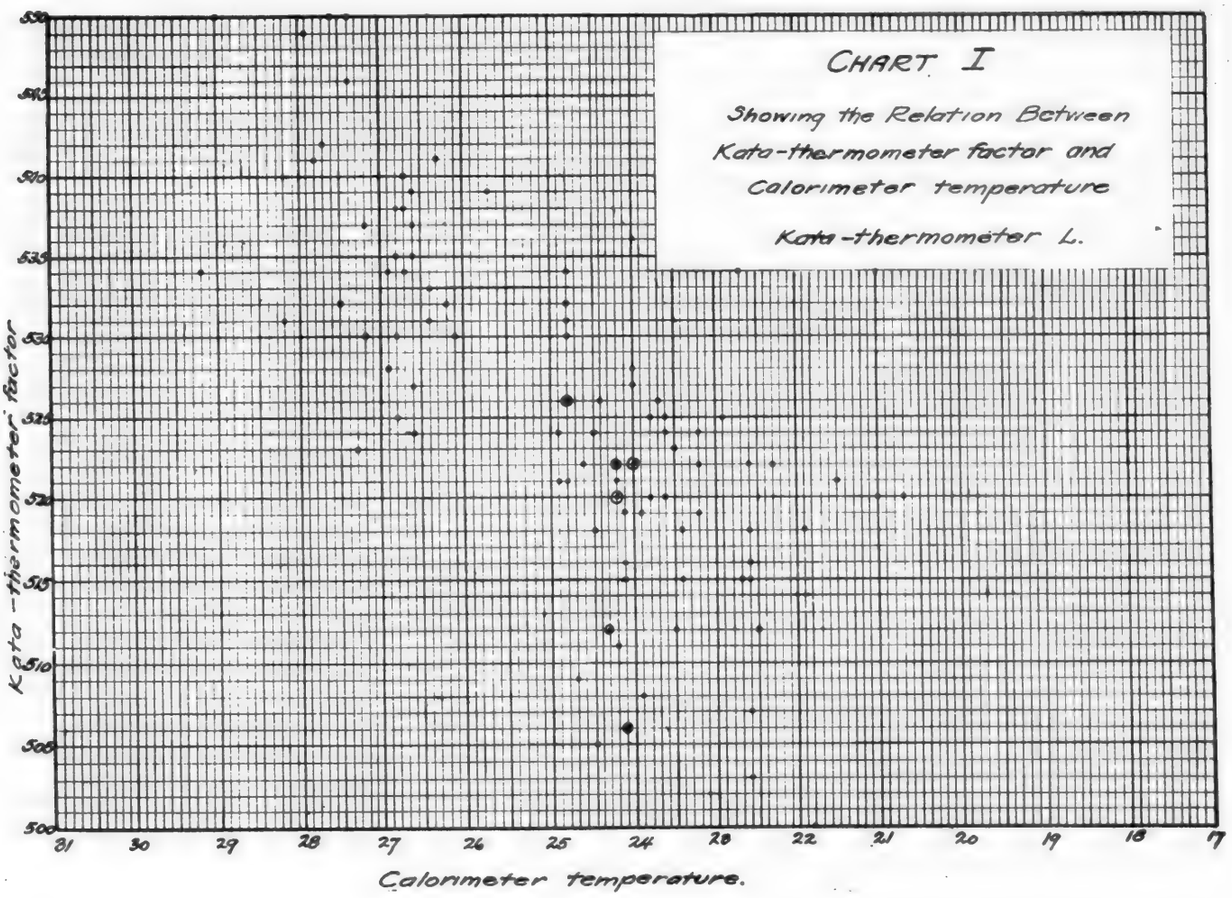


CHART I
Showing the Relation Between
Kata-thermometer factor and
Calorimeter temperature
Kata-thermometer L.
Kata-thermometer factor
500
505
510
515
520
525
530
535
540
545
550
31 30 29 28 27 26 25 24 23 22 21 20 19 18 17
Calorimeter temperature.

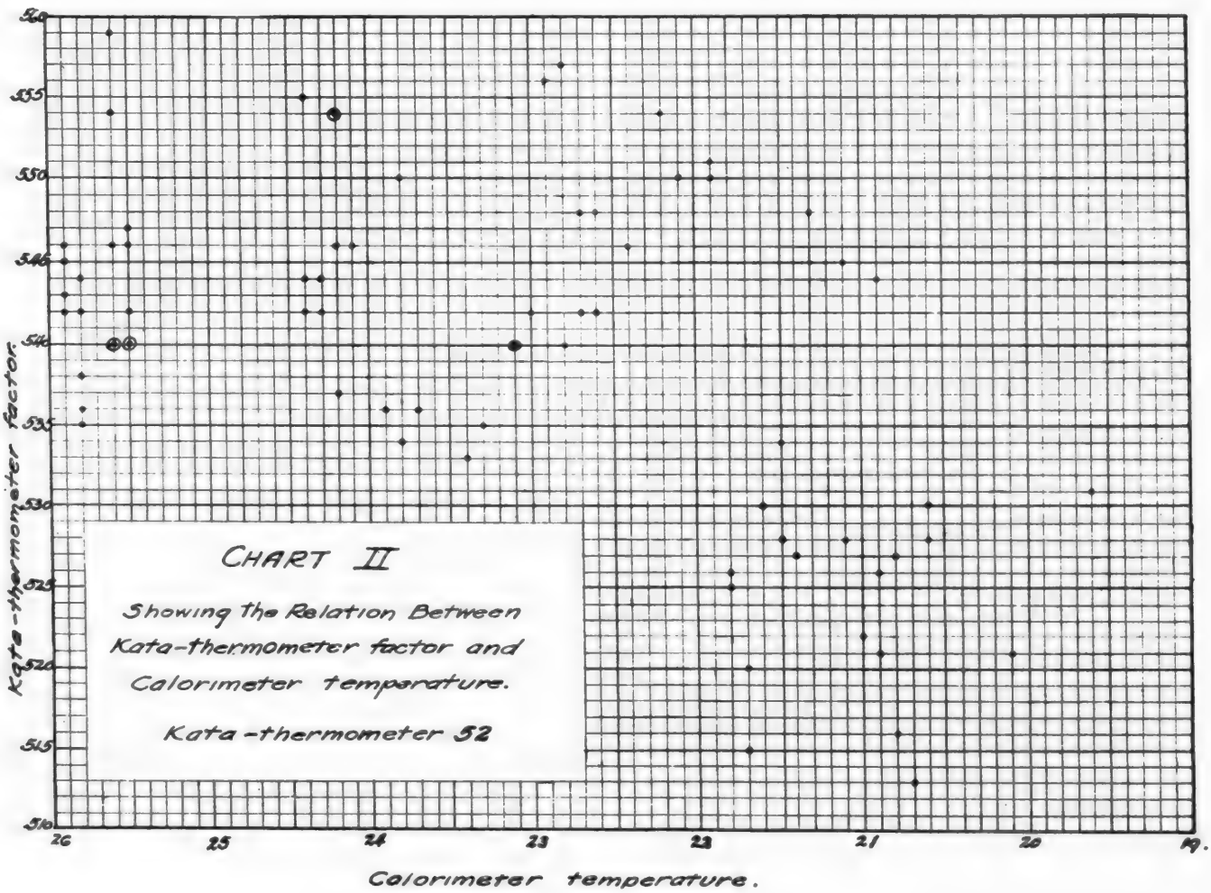


CHART II
Showing the Relation Between
Kata-thermometer factor and
Calorimeter temperature.
Kata-thermometer 52
Kata-thermometer factor
510
515
520
525
530
535
540
545
550
555
26 25 24 23 22 21 20 19.
Calorimeter temperature.

cribed by Hill (previous cit.). The kata-thermameter was heated by holding in a water bath kept at 80° C. until the upper bulb was half full of liquid, then cooled a trifle and re-warmed again. In this manner the two kata-thermometers (the unknown and the comparison) were heated and then inserted in the calorimeter and allowed to cool as simultaneously as possible. The time required for the index to fall from 100° to 95° was read on a stop watch to the nearest tenth of a second, the first of each series of observations being discarded. The temperature of the enclosure was taken by means of the Centigrade thermometer previously described. In this manner 72 observations were made on kata-thermometer No. 52 and 93 observation on kata-thermometer No. L. All of the doors and windows of the room in which the determinations were made were kept closed so as to minimize air motion.

Knowing the temperature of the enclosure and the time required for the index to fall from 100° to 95° the factor in each case was computed by means of the following formula proposed by Hill.

$$K = 0.27\ (36.5—t)\ x$$

Where t = temperature of enclosure, degrees centigrade, and x = time of fall in seconds.

Table I gives the results of observations on kata-thermometer No. L and in Chart I these observations are graphically depicted. Table II shows the observations on kata-ther-

[1] The Science of Ventilation and Open Air Treatment, Med. Res. Com., Part 1, p. 36.

TABLE I--OBSERVATIONS ON KATA-THERMOMETER L.

Observation Number	Calorimeter Temperature Deg. F.	36.5 — t	Time of fall, Minutes	Factor
1	24.8	11.7	167.7	530
2	24.8	11.7	168.2	531
3	24.8	11.7	166.6	526
4	24.8	11.7	165.0	521
5	24.8	11.7	166.4	526
6	24.8	11.7	168.6	532
7	24.9	11.6	167.0	524
8	24.9	11.6	166.3	521
9	24.8	11.7	169.0	534
10	20.7	15.8	121.4	520
11	21.0	15.5	124.8	520
12	21.5	15.0	129.8	521
13	21.9	14.6	131.6	518
14	22.3	14.2	134.8	522
15	22.5	14.0	136.4	512
16	22.6	13.9	135.2	503
17	22.6	13.9	136.8	518
18	22.7	13.8	138.8	515
19	22.6	13.9	135.2	507
20	22.6	13.9	137.8	516
21	22.6	13.9	137.2	515
22	22.6	13.9	139.2	522
23	22.7	13.8	143.8	533
24	23.2	13.3	146.4	524
25	23.5	13.0	148.6	528
26	23.6	12.9	150.4	524
27	23.5	13.0	145.8	512
28	23.4	13.1	146.2	518
29	23.7	12.8	151.8	526
30	24.0	12.6	155.2	522
31	24.2	12.3	157.4	522
32	24.2	12.3	154.4	511
33	24.1	12.4	155.8	519
34	24.3	12.2	155.0	512
35	23.9	12.6	149.2	508
36	23.9	12.6	152.8	519
37	24.0	12.5	154.0	522
38	24.3	12.2	155.2	512
39	24.5	12.1	155.2	505
40	24.1	12.4	151.4	506
41	24.1	12.4	154.6	515
42	24.1	12.4	151.2	506
43	24.1	12.4	154.0	516
44	24.5	12.0	162.2	524
45	24.7	11.8	159.2	509
46	22.9	13.6	143.6	525
47	23.2	13.3	144.5	519
48	23.4	13.1	145.5	515
49	23.6	12.9	150.9	525
50	23.8	12.7	151.8	520
51	24.0	12.5	156.6	528
52	24.2	12.3	157.2	522
53	24.2	12.3	156.3	520
54	24.2	12.3	156.8	520
55	26.2	10.3	192.2	532
56	26.4	10.1	194.9	531
57	26.6	9.9	197.0	527
58	26.6	9.9	201.1	537
59	26.7	9.8	203.0	534
60	26.7	9.8	204.4	536
61	26.8	9.7	205.4	538
62	26.8	9.7	204.4	535
63	26.8	9.7	200.4	525
64	25.7	10.8	185.3	539
65	26.1	10.4	188.0	530
66	26.4	10.1	195.4	533
67	26.6	9.9	199.9	535
68	26.9	9.6	206.1	534
69	27.2	9.3	214.0	537
70	28.2	8.3	237.9	531
71	29.0	7.5	271.1	550
72	26.3	10.2	196.6	541
73	26.6	9.9	201.5	539
74	26.8	9.7	202.2	530
75	27.3	9.2	210.6	523
76	29.2	9.3	213.3	534
77	27.4	9.1	224.9	550
78	27.8	8.7	229.4	541
79	27.9	8.6	236.1	549
80	26.7	9.8	203.8	540
81	27.4	9.1	222.3	546
82	27.6	8.9	229.8	550
83	27.7	8.8	229.0	542
84	27.5	9.0	218.8	532
85	27.2	9.3	211.1	530
86	26.9	9.6	204.4	528
87	26.6	9.9	196.6	524
88	23.2	13.3	144.9	522
89	23.6	12.9	149.4	520
90	23.8	12.7	153.2	525
91	24.0	12.5	156.1	527
92	24.2	12.3	157.4	521
93	24.4	12.1	160.9	524
94	24.5	12.0	160.4	518
95	24.6	11.9	162.5	522

TABLE II--OBSERVATIONS ON KATA-THERMOMETER NO. 52.

Observation Number	Calorimeter Temperature Deg. F.	36.5 — t	Time of fall, Minutes.	Factor
1	21.1	15.4	131.2	545
2	21.9	14.6	140.0	550
3	22.2	14.3	141.0	554
4	22.6	13.9	146.2	546
5	20.9	15.6	129.2	544
6	21.3	15.2	134.0	548
7	21.5	15.0	132.0	534
8	21.9	14.6	140.0	551
9	22.1	14.4	142.0	550
10	22.4	14.1	144.0	546
11	22.8	13.7	151.0	557
12	22.9	13.6	151.5	556
13	23.1	13.4	149.0	540
14	23.0	13.5	149.0	542
15	22.8	13.7	146.0	540
16	22.7	13.8	145.5	542
17	22.6	13.9	144.5	542
18	22.7	13.8	147.0	548
19	23.8	12.7	160.8	550
20	24.2	12.3	166.8	554
21	24.4	12.1	166.4	544
22	24.4	12.1	170.6	555
23	24.4	12.1	166.8	542
24	24.3	12.2	165.1	544
25	24.2	12.3	161.6	537
26	24.2	12.3	166.5	554
27	24.3	12.2	164.4	542
28	24.2	12.3	164.0	546
29	24.1	12.4	163.0	545
30	23.9	12.6	167.2	536
31	23.8	12.7	166.2	534
32	23.7	12.8	166.2	536
33	23.4	13.1	161.2	533
34	23.3	13.2	160.0	535
35	23.1	13.4	149.8	540
36	19.6	16.9	116.6	531
37	20.1	16.4	118.0	521
38	20.6	15.9	123.2	530
39	20.7	15.8	120.0	513
40	20.8	15.7	121.6	516
41	20.8	15.7	124.2	527
42	20.9	15.6	124.4	526
43	20.9	15.6	123.8	521
44	21.0	15.5	124.5	522
45	20.6	15.9	122.4	528
46	21.1	15.4	127.2	528
47	21.4	15.1	129.2	527
48	21.5	15.0	130.8	528
49	21.6	14.9	132.0	530
50	21.7	14.8	130.2	520
51	21.7	14.8	129.0	515
52	21.8	14.7	132.4	526
53	21.8	14.7	132.2	525
54	25.8	10.7	187.3	543
55	25.9	10.6	190.3	545
56	25.8	10.7	186.2	536
57	25.9	10.6	189.8	543
58	25.9	10.6	189.0	542
59	25.8	10.7	185.0	535
60	25.8	10.7	186.7	538
61	25.8	10.7	188.6	542
62	25.9	10.6	190.4	546
63	25.5	11.0	184.6	547
64	25.5	11.0	181.4	540
65	25.5	11.0	184.2	546
66	25.6	10.9	183.8	540
67	25.5	11.0	182.6	540
68	25.5	11.0	182.2	542
69	25.6	10.9	183.0	540
70	25.6	10.9	185.0	546
71	25.6	10.9	187.6	554
72	25.6	10.9	189.6	559

mometer No. 52 and in a like manner these are graphically shown in Chart II.

The factor of kata-thermometer "L," it will be observed from the tables, varied from 550 to 503. The maximum time of fall observed on this instrument was 271.1 seconds (at 29.0°) and the minimum 121.4 seconds (at 20.7°). In the case of kata-thermometer No. 52, the factor varied from 513 to 559. A maximum time of fall of 190.4 seconds was observed (at 25.9°) and a minimum time of fall of 116.6 seconds (at 19.6°). Deriving the heat loss of these thermometers by dividing the respective factors by the time of fall we get the following:

	Heat loss in millicalories per sq. cm. per second	
Kata 52	Factor	Factor 513
Maximum Kata time 271.1	2.03	1.86
Minimum Kata time 121.4	4.52	4.14
Kata L	Factor 550	Factor 503
Maximum Kata time 190.4	2.93	2.70
Minimum Kata time 116.6	4.79	4.40

The maximum percentage variation in the factor of kata-thermometer No. L is 8.6 and that of kata-thermometer No. 52 is 8.3.

It would seem, therefore, from these observations that the maximum error in kata-thermometer readings, due to inaccuracy in factoring, is somewhat less than 10% when observations are made at temperatures between 20° and 29° Centigrade. The graphs suggest that in general a lower factor-value is associated with a lower temperature and vice versa; but the relation indicated is by no means a close one, mere random variations evidently playing a very large part in the problem.

INSTRUCTION COURSE FOR CUSTODIANS AND JANITORS

Lesson 9—Warm-Air Heating

BY EDWIN S. HALLETT,

Chief Engineer, St. Louis Board of Education.

THE operation of warm-air furnaces with or without fans requires special skill at the hands of the custodian or janitor. The furnace located within the school room, as is often the case with the portable schools, is the source of the greatest annoyance to the Building Department and suggestions will follow here for their elimination.

A very common type of furnace is built by taking a large stove-like firepot enclosed by a sheet-iron jacket, with a fresh-air intake through the floor and a warm-air duct and diffuser projected into the room. An attempt is usually made to do an impossible thing in expecting that air will come in through a furnace into a tightly closed room. The warm air that does come in forms a stratum near the ceiling and the floors are always cold. To correct this condition it is necessary to run a duct from the base of the heater under the floor and connect it through a floor register to the farther end of the room. A branched duct with two registers will be better. This will force the warm air to the floor in the cold end of the room and the air will rapidly recirculate through the furnace. It is possible in this way to move the warm air to any place desired. The furnace with a power-driven fan must have the vent or return register on the side of the room at which the furnace is located as the air movement is sufficient to rebound, but with gravity air movement the vent must be at the opposite side. Attention to these directions will completely transform the efficiency of these old furnaces.

Warm-air furnaces installed in the basement have hitherto been much less effective than they should have been. The old practice of entering the warm air through floor registers and trusting to leakage at the doors and windows for air change is too crude for present-day engineers. Run the warm air ducts up near the ceiling and put return ducts in the floor at the coldest spot. The floor vents should be made adjustable in size to keep a balance in the various rooms on the furnace.

The fresh-air intake of a furnace piped up as directed above should be much smaller than is necessary when no air is returned from the building. Where such intake is large it should be partially closed to assist in the return movement from the rooms. The primary purpose of this change is to get a distribution of warm air, rather than fuel economy, although it does that in a remarkable way.

The repairs on warm-air furnaces are troublesome and expensive. The breaking of cast-iron firepots makes a continuous stream of repairs in a city with a lot of portable schools. The cost of repairs is great because the furnace must be taken down and reassembled, jacket, ducts and all. The wrought-iron furnace which uses a fire-clay tile lining, which is repaired by inserting a new tile, is much more economical and satisfactory. The grouping of portable schools having six or more rooms connected by a common vestibule and heated by a common furnace is preferable to the individual furnace although a small fan will be necessary in installations larger than four rooms.

The firing of these round fire-pot furnaces to produce uniform heat and to prevent smoke requires special instruction. They are probably most often supplied with hard coal or coke, although with a fair draft the medium soft coals can be successfullly burned. If soft coal is used the coking method of firing will be necessary to prevent objectionable smoke. When the fire has been started with kindling and coal the addition of fresh coal on the top of the burning fire will smother the fire and waste the volatile portion by driving it off in smoke. Do not do that. Take a long shovel and push back the burning coal and deposit the fresh coal down at the front beside the fire. The depth of the fire will depend upon the draft or height of the chimney. Do not "poke" the fire. Stirring the mass of burning coal will cause it to mass together like mortar and the air can not pass through it and the combustion stops. A shaking or rocking grate will open up the fire and give the draft necessary if the bar is kept out. The soft coal should be broken to 3-in. or 4-in. size as large lumps permit the gas to be wasted. The draft should be regulated by opening a check damper in the pipe or some place above the fire and not by closing the damper in the ash pit. All the cracks or joints in the furnace must be kept air tight as very small air leaks destroy the draft. Cracks

in the fire-pot or radiator permit cool gas leakage into the building and must not be permitted. Furnace cement can be used for closing all such joints, except in the fire-pot where the temperatures are too high.

Warm-air furnaces should have a temperature control installed to operate the check damper. These devices are operated by a small motor or sometimes by a spring to lift the damper. The thermostat element is placed in the room desired and connected by an electric wire. It is impossible to have satisfactory heat from any source without heat regulation. The fact that such a regulator saves enough fuel to pay for the expense of the apparatus will make it an easy matter to secure.

Warm-air furnaces do produce good ventilation because the air is in motion and the fresh-air inlet supplies sufficient fresh air. If the fire is permitted to get too hot, so hot as to redden the upper radiating portion a bad odor will be given off. The temperature regulator should prevent this.

The humidifying part of furnaces has been the most difficult to handle. The ordinary water-pan is seldom sufficient. There are on the market very successful humidifiers which are sold separately and add considerably to the cost but are fully justified where good living conditions are desired. Where ozone is desired in a home or school the warm-air furnace, properly installed and controlled, is a most satisfactory and hygienic heating apparatus. It has suffered most from the lack of scientific handling and with the better janitor service these furnaces may be expected to gain in popular favor.

Questions.

1. Why does a furnace fail to heat a closed room?
2. What will prevent the stratum of hot air at the ceiling?
3. How will recirculation through floor ducts aid in heating?
4. Where should registers be placed with reference to the heater?
5. With basement furnaces why is a high inlet better?
6. How may cold corners or cold walls be warmed?
7. What are the objections to cast iron fire pot furnaces.
8. When is a fan necessary with warm air furnaces?
9. How should soft coal be fired in furnaces?
10. How is the temperature controlled in furnace practice?
11. What is the ventilating value of warm air furnaces?

BACK TO FIRST PRINCIPLES

Lesson No.6—Human Ventilation Requirements

BY REID DAVIES

AS explained in Lesson 1, the air that people breathe must be pure, if they are to remain comfortable and healthy. The process of respiration in which air is directly involved, together with the allied processes of digestion and circulation, form as truly an energy transformation system as does any furnace-boiler-piping combination. The principal difference between the two systems lies in the rate of combustion, since the essential element in the fuel supply is the same for both, Mechanical equipment for the generation of heat from the burning of garbage is quite common and obviously the fuel fed to this apparatus is simply the waste matter from the "fuel" with which we are in the habit of stoking ourselves. The mechanical device for combustion of garbage is called an incinerator and is akin to other forms of furnaces. The corresponding human equipment and processes are more complicated and certainly more interesting.

RESPIRATION, DIGESTION AND CIRCULATION

The human lungs serve as the point of entrance of oxygen to the body and the point of exit of carbon dioxide. While the alternation of inhaling and exhaling processes seems to suggest definite periods of oxygen entrance and of carbon dioxide release, as a matter of fact these are simultaneous processes which are as continuous as the flow of blood in the human circulatory system.

While the chemistry and physics of these processes are somewhat intricate, the mechanics of the same are fairly simple. Expansion of the lungs draws in air containing oxygen which passes through the membranes of the blood vessels and enters into loose combination with a substance in the red blood corpuscles, called haemoglobin. It is then pumped by the heart through the arteries to all parts of the body where its action on the carbon in the tissues produces carbon dioxide. This gas then passes back through the walls of the veins and also enters into a loose combination with the haemoglobin by which it is carried back to the lungs and there released.

The circulatory system by which is effected this transfer of oxygen and of carbon dioxide, consists of two distinct parts. That leading from the lungs to the tissues is called the arterial system and under normal conditions the arterial blood contains about 19 volumes of oxygen and about 34 volumes of carbon dioxide per 100 volumes of blood. The venous system leading from the tissues back to the lungs carries blood which under normal conditions contains about 12 volumes of oxygen and about 41 volumes of carbon dioxide per 100 volumes of blood. Evidently the aeration produced by the lungs results in a gain of about 7 volumes of oxygen and a loss of about 7 volumes of carbon dioxide per 100 volumes of blood passing through them, while the combustion processes in the tissues balance the above effect by taking about 7 volumes of oxygen from the blood and giving to it about 7 volumes of carbon dioxide per 100 volumes of blood.

Since the preceding figures represent approximately the capacity of the blood for transfer of these gases, the difference in quantity of oxygen intake and carbon dioxide exhaust between periods of rest and periods of intense activity must be secured by increase in the rapidity of circulation. That this is actually the case can be observed readily by noting differences in pulse frequency. The corresponding variation in frequency of respiration processes is thought to be controlled by the pressure of carbon dioxide in the alveolar air—that is, the air content of the smaller lung passages which is affected by each inspiration and expiration of air but is not completely determined by any single act of inhaling or exhaling. Inspired dry air contains about 0.03% of carbon dioxide and about 21% of oxygen, while dried expired air contains about 3.5% of carbon dioxide and about

17% of oxygen, but in the alveolar air the percentage of carbon dioxide shows much smaller variation. Even a slight change in this percentage acts upon the controlling nerve centers in the lungs to produce acceleration or retardation of the respiration frequency. Viewed from this angle it is apparent that the presence of carbon dioxide in vitiated air is a safety measure rather than a danger since without any direct ill effect upon the lungs it has the good effect of speeding up the breathing frequency to meet the condition of insufficient oxygen supply.

The question of breathing frequency brings up a point of immediate interest, that of the volume of air required for health and comfort. This depends upon the state of bodily activity as well as questions of age, health, and air contents. Because of the number of variable factors, no hard and fast figures are possible, but even the maximum requirements for purposes of oxygen supply are considerably under the widely standard specification of 30 cu. ft. of fresh air per minute per person. This specification, while supplying fresh air faster than is required for oxygen supply alone, is not excessive in connection with the problems of removing odors and used air and of producing a comfortable degree of air motion.

From the preceding description it is apparent that the operation of breathing has a cooling tendency in both of its phases, since the air inhaled is usually below the temperature of the body (interior parts) while the air exhaled is at about the same temperature as the body. The effect which balances this heat loss is the combustion which occurs in the tissues. This combustion is no less a means of heat release because it occurs under conditions which prevent the rapidity of combination and the high temperature produced in a furnace. Fuel for the human combustion process is supplied by the digestive system and the amount of heat liberated per pound of fully-digested combustible is the same in the human furnace as it would be in any other kind of a furnace. While drawing comparisons between the human body and the mechanical apparatus for accomplishing somewhat similar thermal results, it is interesting to note that experiments have proved the over-all efficiency of the body to be considerably higher than that of any mechanical combination yet devised. And the human body is not the most efficient among organic forms in this respect, for observations on fish migration have proved that certain species, notably the mackerel, possess the ability to cover immense distances at continuous high speed on meager supplies of food. Oxygen for the fish's combustion process comes from air dissolved in the water.

AIR SOURCE

A great many of our life essentials—most of them, in fact—require some form of processing and some manner of distribution before they can be applied to the satisfaction of human requirements. Building materials have to be quarried, mined, refined, manufactured, and transported from supply to demand before they can be utilized. Materials for food and clothing have to be raised, gathered, processed, and transported in the same general way in order to become of use. Even water, which we regard as plentiful and practically free, has often to be impounded in expensive reservoirs, filtered and chemically treated by expensive processes, and piped through expensive distributing systems before it can be placed at the service of large communities. Now air is no exception to this general rule, although it is even more plentiful and cheap than water and although its natural diffusion characteristic makes its distribution in large measure automatic. To insure its fitness for breathing and to insure the supply of a continuous stream of such pure air, it is necessary to provide in many cases elaborate equipment between the supply source—the adjacent outside atmosphere—and the interior portions of structures where the demand exists.

SUPPLY METHODS AND APPARATUS

The methods and apparatus used for getting an air supply from the outside atmosphere to the inside center of demand have varied with the changes in types of building construction and with growth and refinement in human tastes. The Indian who felt a need for improved ventilation probably kicked another hole in his wigwam. While it had some disadvantages from the ventilation standpoint, this process was both quick and effective. It finds its modern counterpart in the opening of windows and doors. The main difficulty of this method was that the Indian could not kick shut the hole in his wigwam by reversing the direction of applied force, but tradition has it that he accomplished the mending of this hole indirectly by imparting pedal encouragement to the squaw.

When the aborigine scrapped his wigwam for a mud-hut, he lost the power of kicking an improved ventilation characteristic into his abode, but gained in other directions. By leaving a hole in the roof of the hut and building a fire under the hole, he was enabled to obtain the elements of combined heating and ventilation. Heat regulation was secured by varying the amount of fuel fed to the fire. Ventilation control was obtained by manipulation of the cloth or skin flap which served both as a door and a damper for the hut. This general method of ventilation by stack effect—the rise of heated air sucking in cold air at the bottom—is familiar to us in the open fire-place and the warm-air furnace.

The third general method of maintaining a continuous supply of fresh air may seem more exclusively modern than the other two, but even this had its early form. The renowned Cleopatra is pictured as being courted amid the breezes from Nubian-wielded fans and it seems reasonable to suppose that, combined with its advantage as a chaser of ubiquitous flies, this service had the added value of supplying improved ventilation about the royal divan. But with the growth of ventilation requirements has come extensive change from the Cleopatran standards in ventilating equipment. The modern fan has more blades and moves faster and the modern prime mover has a higher effective horse-power than had those of old Egypt, and the capacity for air movement has increased in proportion.

For insuring a continuous change of air in an interior there is nothing that can beat the mechanical draft system of blowing air in at one place and sucking it out at another—providing the fans are of sufficient capacity and the inlet and exhaust openings to the interior space are properly placed. However, there is some difference of opinion as to what are the right places. One group of engineers holds that the supply registers (the supply being heated usually) should be near the ceiling and the exhaust registers near the floor. The other group holds that supply registers should be near the floor and exhaust vents near the ceiling. The first group hates to see fuel waste by escape of warm air from the room, while the second is willing to make this sacrifice to the cause of ventilation. With the second arrangement the rise of heated air produces a natural flow from entrance to exit. Heated exhaust from the lungs which it is desired to remove from the room, has the same direction of flow and its removal is thus facilitated.

IMPURITIES IN AIR

But the impurities in expired air are not the only ones which have to be considered in the matter of air purification or ventilation. Other forms of impurity which may be found in the air of interiors are explosive or combustible gases, poisonous

gases, bacteria, dust, offensive odors (due to the presence of gases which may be otherwise harmless), and excessive CO_2 which is odorless, non-poisonous, and incombustible, and only dangerous because an excess of it implies an insufficient supply of oxygen for breathing.

AIR PURIFICATION METHODS

When the source of the impurity is located within the space to be ventilated and is capable of manual control as in the case of leaking gas pipes, improperly operated stoves, decaying organic matter, or dust-producing machinery, the obvious way to secure purification is to remove or so enclose the source of impurity that there is no opportunity for these impurities to escape into the surrounding air. When this is not possible the next best thing is to bring in and take out air from this particular space in such large volumes that the impurities are diluted to the point where they are practically harmless.

But when the outside air contains the objectionable impurities, the only chance for relief lies in processing this air so as to remove whatever impurity makes it unfit for breathing in any particular case. Explosive or poisonous gases present in dangerous quantities in the outside air are matters for legal rather than mechanical relief measures. It has been found that bactria do not pursue a free-moving or independent existence in the air but are associated with the presence of dust, so that the removal of bacteria is a dust-removal problem. The killing of bacteria is another thing entirely. This is a special health measure accomplished by spraying or fumigation with sulphur or formaldahyde or other similar agent and attention is not confined in this process to the air alone but includes the surfaces of all objects within the infected region. But it is of interest to note that a somewhat similar action on bacteria in the outside air is exercised by the actinic or ultra-violet rays of the sun. The heating of air to very high temperatures would serve similarly to kill bacteria contained in it.

Special devices for killing bacteria are rendered unnecessary by the fact above mentioned, that removal of the dust content of the air accomplishes the simultaneous removal of the bacteria. Various methods of dust removal are in common use. Most common is the filtering of the air through fabric screens. This removes only the larger particles and has the disadvantage of greatly obstructing the flow of air. An alternative measure which has found wide use is the washing of the air with sprays of water in very finely divided condition. This cleans the air in much the same way as does rain, but can be made to do a much better job in the way of dust removal than does the usual rain storm. Where the dust impurity is in very finely divided form as smoke and where the material of the impurity is oxidizable it can often be removed by injecting into the air stream a stream of ozone. This gas is an allotropic form of oxygen, the molecule of which differs from the ordinary oxygen molecule by containing three instead of two atoms of oxygen. Ozone is very unstable and readily releases its extra oxygen atom in the nascent state when it is a much more active oxydizing agent than the molecular form of oxygen.

As a matter or fact, ozonation is most valuable as a means for removing from the air those impurities which are included under the head of offensive odors and which are in a gaseous form which favors the action of the ozone. It is worthy of note in connection with this use of ozone for removing foul odors that the production of ozone by the usual electric discharge method, if improperly carried on, will result in the simultaneous production of peroxide of nitrogen which is itself offensive to the sense of smell and is also highly poisonous. Obviously this action, unless provided for, would defeat the main object of the ozonation process as a method of air purification. Ozonation gives the best results when the amount of ozone released is confined to the actual purification needs.

The least dangerous form of air impurity is that caused by an excess of carbon dioxide, although for years this inert and inoffensive gas was the bug-bear of the ventilating engineer and had to carry the burden of opprobrium now allotted more justly to its first cousin the monoxide. If there is enough carbon dioxide present in the air it will not support life, but suffocation will be due entirely to the absence of oxygen and not directly to the presence of the other gas. The only way to cure excess of carbon dioxide is to bring in more oxygen.

SOURCES OF AIR IMPURITIES

The sources of air impurities located within a structure are of so many kinds and vary so greatly with the class of building and its principal function that no attempt can be made here at a classification of the same. As far as these interior sources are concerned, the special conditions of each particular case offer the only logical basis for efforts at prevention or cure. Of course one source of impurity in any populated interior is the expired air from the human lungs. Normally the rate of air pollution from this source is not high but in the cases of school rooms and auditoriums where large numbers of people are gathered for considerable periods, and in the case of hospitals where contagious diseases are treated, this source of air pollution is of primary interest. The source can not be removed in these cases and the only solution of the problem lies in removing the expired air fast enough to maintain the interior air in satisfactory condition for breathing.

The main sources of impurities in the outside air are fewer in number but of more vital interest, because when the outside air is impure there is no chance for interior air to be pure except by special treatment. One prolific source of outside air pollution is the discharge from chimneys of factories, locomotives, and even office buildings and residences. In most communities of any size there are local statutes aimed at abatement of the smoke nuisance. Incidental to certain kinds of soil and to thoroughfares where traffic is particularly dense the pollution of the air by dust is accomplished by any strong wind. The paving of dirt roads decreases this evil as does the watering of paved streets. The oiling of dusty roads and streets serves to lay the dust more permanently than does watering. There is no positive cure or sure method of preventing this evil. Another less common source of outside air impurities lies in the exhaust of poisonous or unpleasant fumes and odors from industrial plants. Sometimes this exhaust is inevitable and the importance of the industry is such that it has to be tolerated, in which cases the only sure relief lies in living to windward of the plant and as far as possible from it. In most cases, however, the exhaust can be so treated before its discharge that there is considerably less air pollution or none at all. Avoidable pollution of the air is as much a crime as the intentional pollution of a well or a stream from which people have to secure their water supply.

(To be continued.)

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IT IS very gratifying to note the quick response on the part of our readers to the invitation published in last month's issue for expressions of opinion on the kinds of articles and topics they would like to see published in THE HEATING AND VENTILATING MAGAZINE. Already a variety of topics has been proposed, the following being some of the more suggestive ones:

Formulas and examples for figuring indirect heating systems where the air for ventilation is heated by pin section or Vento radiation.

Formula for proportioning aspirating radiators in vent flues. As was pointed out, where States have adopted ventilation laws, the rulings vary considerably, Indiana, for example, giving the minimum amount of radiation as 27 sq. ft. per stack, while Illinois specifies "at least 9 sq. ft." in aspirating radiators.

Conversion of rectangular ducts into square or round ducts of equal friction loss.

The invitation may be considered as still standing and can with advantage elicit a response from every one of our readers because every engineer has his knotty problems which very often remain unsolved through lack of opportunity to delve into them in the ways that are available to a technical journal. We might add that every inquiry received will be answered either direct or through our reading columns, so that, whether or not the suggestions form the basis of a published article or topic, the desired information, if obtainable, will be forthcoming.

AN ITEM in last month's issue on "The Trend from Down-Draft to Up-Draft in Smokeless Boiler Design," it should be pointed out, had reference more particularly to the types of house-heating boilers which ordinarily are operated by the householder himself and which have to be left without attention for rather long periods. In the cases of boilers that are under the care of a regular fireman, it is only fair to say that no such trend is evident.

The advantages of the down-draft principle of combustion are too well established to admit of argument at this late day and yet when there are such factors to be considered as those mentioned it bcomes necessary to balance the best theory with the practical exigencies of the situation and this, we take it, explains the recent increase in the number of types of up-draft smokeless heating boilers.

HEAT by Radiators" is the slogan which has been adopted by the National Trade Extension Bureau for a sales campaign intended to cover the heating trade throughout the United States. We feel that special attention should be directed to this effort because the numerous movements inaugurated by the Bureau in the interests of the plumbing trade have somewhat overshadowed its efforts for the advancement of the heating and ventilating industry.

The material for this campaign is published in the shape of a broadside circular, containing some 36 pieces of newspaper copy and cuts which the heating contractor can use in his local newspaper to further the objects of this drive.

The campaign will go on during October and everyone in the trade can take part in it by making it a point to talk "Heat by Radiator" at every opportunity. The plans have been well laid for a successful drive and, like all effective propaganda, need concerted action on the part of everyone connected with the heating industry.

IN the results of the Landis award in the Chicago building trade dispute, is seen again the hopelessness of any effort to regulate building conditions, which does not include every party to those conditions and cover every element in them. Judge Landis made a most thorough study of the situation and promulgated a wage cut sufficiently drastic to cure any industrial situation of any ailment that it might have, and yet the dispute still smoulders. The fact that the matter can not be successfully handled piece-meal, is brought out by Judge Landis himself in his scathing arraignment of conditions in the materials end of the building industry, which lay beyond the scope of his jurisdiction in this case.

The trouble with the building industry is this, that each group within it which could organize, has done so for its own exclusive benefit and has made a point of feathering its own nest regardless of the rights of any other group. This is an easy mistake to make, especially when everybody is doing it. But the general public, which has the largest single interest in securing healthy conditions in the industry, has had no organized status in it. For this reason the public has been a particular mark for attack and when the results have been counted for each agreement and each disagreement between groups, the public has always had to pay the piper.

PRESENT DEVELOPMENT OF THE CENTRAL STATION HEATING INDUSTRY

BY FRED B. ORR.

(From a paper presented before the Smoke Prevention Association, in St. Louis, June 1, 1921.)

AT the present time there are well over 400 companies throughout the country engaged in central heating. In practically every large city some attempt has been made to introduce this ideal method of service. Many of these attempts have met with financial disaster, due to the impossibility of securing just rates. Perhaps the majority of heating companies are controlled by the same interests which furnish electric service, although the largest heating company in the world, the New York Steam Company, is totally independent of any such affiliation.

PRESENT TENDENCY TO HEAT WITH LIVE STEAM.

Early developments in their field followed the method of heating with exhaust steam from reciprocating engines. The range of applicability was necessarily limited, due to the low pressures possible. Following this, live steam heating grew into favor with its higher pressure, smaller distributing pipe lines and greater extent of territory that could be covered. Attempts were then made to bleed intermediate stages of turbines after considerable work had been performed. At the present time the tendency among practically all large companies is to expand the "live steam idea." This is true of the systems in Chicago, Detroit, New York and other large cities. In St. Louis both schemes are followed.

It may be safely stated that no other agency is equally effective as a prevention of smoke, and were it not for serious drawbacks involving the financial returns from such ventures, time would see a more universal expansion of centralized or consolidated heating plants. The advantages are too familiar to you to necessitate more than a resumé of the principal points.

THE SITUATION IN CHICAGO.

In Chicago, for example, the activities of the heating company are confined to a very limited area, serving less than seventy customers in twelve city blocks. The average yearly coal consumption is close to 100,000 tons. Were it not for the system of interconnections in use, this coal would be consumed in forty or more separate boiler plants, whereas the load may be carried at present from seven large plants in winter and five in summer. Plans are in formation which contemplate even furthur consolidation of plants, which would reduce the number required.

EFFECT OF PRESENT CONDITIONS IN THE MINING INDUSTRY.

Small boiler plants are limited in their choice of fuel, and the unsettled condition of the mining industry precludes any uniformity of supply, whereas the larger and more efficient plants have the advantage of greater flexibility in this respect. The advent of forced-draft stokers makes it possible to operate economically on low grades of fuel, and the heating companies are enabled to invest considerable sums of money in the most up to date equipment with the certainty of obtaining efficiency and smokelessness.

IMPROVEMENT IN UNDERGROUND INSULATION METHODS.

With reference to the distance which steam may be transmitted, this is solely a matter of initial steam pressure and design of distribution systems of piping. The progress in this field has been very marked and underground insulation methods are now very efficient. nI the large cities it is probable the density of load will demand more than one supply center, since it would be a problem to deliver great quantities of fuel and receive ashes at one point. In smaller cities one plant suffices.

CENTRAL HEATING SUCCESSFUL IN PROSPEROUS AND PROGRESSIVE COMMUNITIES.

It is found that to yield even a bare profit, a price must be set for steam which is in excess of the householder's cost for fuel and repairs and hence it is only in prosperous and progressive communities that central heating has succeeded. Many companies are seeking to withdraw from business due to the impossibility of securing adequate and just rates; but ultimately the idea will be expanded as the advantages of the service are realized. "Once a customer always a customer" is a well-demonstrated fact.

CENTRAL HEATING THE METHOD OF THE FUTURE.

The course of modern economics will lead eventually to the general production of heat from centralized or grouped plants in a similar manner to the course of development in electrical development; and future requirements will undoubtedly demand the abolishment of small domestic plants, both on account of fuel waste and smoke. This will be increasingly true as fuel becomes more expensive. This method will reduce labor, the volume of cartage through streets, increase cleanliness and safety.

Standard Connections for Condensation Meters.

In laying out a meter connection for the metering of steam with a condensation meter, there are many things which the engineer should take into consideration. In the case of new building construction, it is easy to select a location suitable for the convenient reading, repairing, adjusting and testing of the

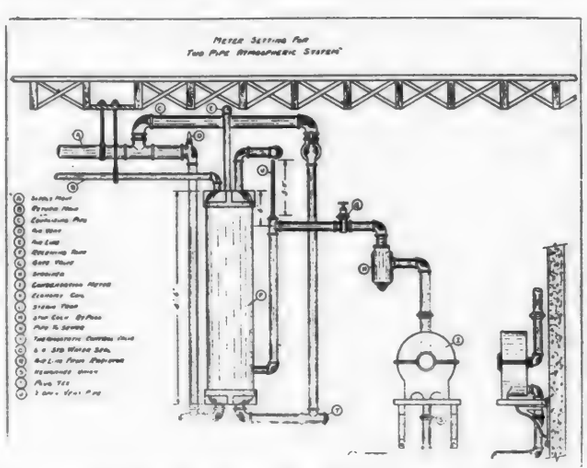


FIG. 1—METER SETTING FOR TWO-PIPE ATMOSPHERIC SYSTEM.

meter as well as specifying certain steam fitting requirements necessary for giving the best metering results. With old buildings the problem often becomes quite complicated, as the piping and equipment are already in place and it would often mean

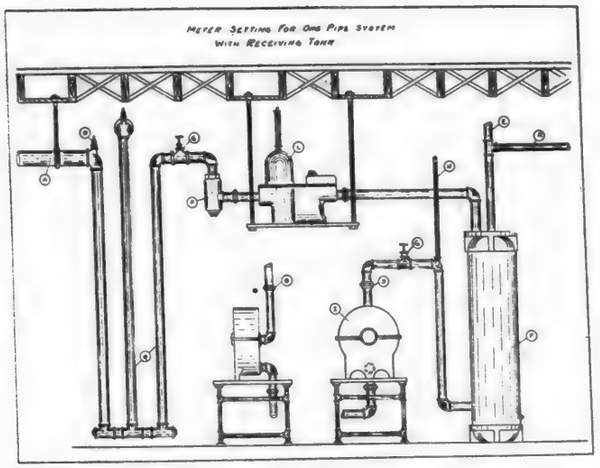


FIG. 2—METER SETTING FOR ONE-PIPE SYSTEM WITH RECEIVING TANK.

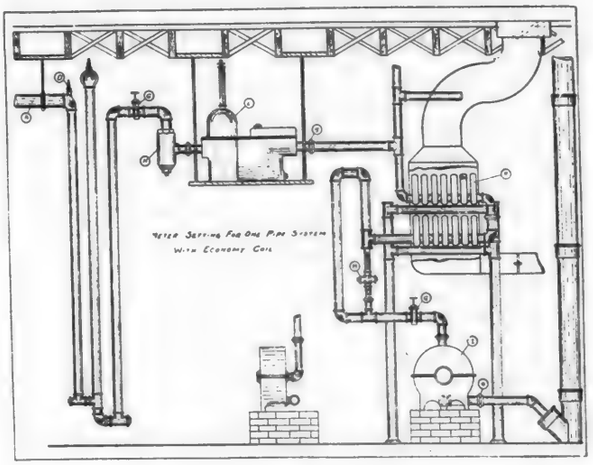
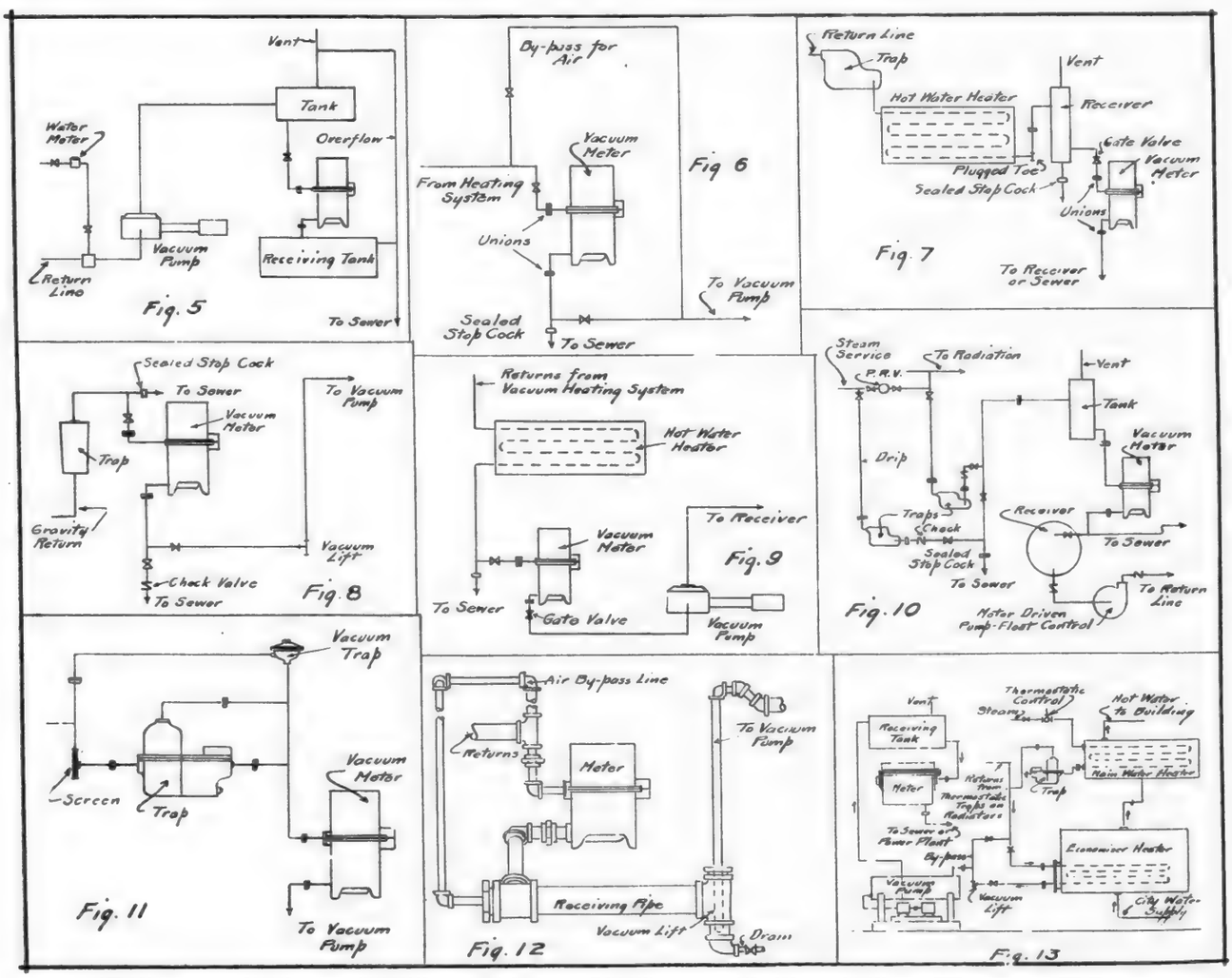


FIG. 3—METER SETTING FOR ONE-PIPE SYSTEM WITH ECONOMY COIL.

the expenditure of considerable sums of money to make the changes which the heating company desires. The only thing to do in a case of this kind is to select the layout which will accomplish the desired results with the least alterations.

A few connections, which have been tried out and found satisfactory, are shown here as a step towards the standardization of condensation meter connections. Figs. 1, 2, 3, and 4 are designed more for residential heating where the condensate is wasted to the sewer, while Figs. 5 to 13 apply to more complicated and larger steam using services, where it is desirable to return the condensation to the steam generating plant. The engineer will have to choose the connection best suited for his requirements and possibly modify or combine different features to obtain the desired results.

Condensation meters should not be worked under pressure and on all gravity metering a vent should be placed ahead of



METER SETTINGS FOR INSTALLATIONS WHERE CONDENSATION IS RETURNED TO STEAM-GENERATING PLANT.

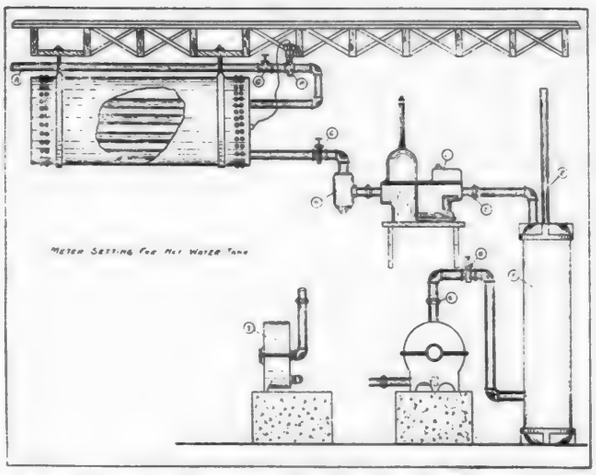


FIG. 4—METER SETTING FOR WATER HEATER TANK.

the meter to prevent an excess pressure on the meter inlet. A vented tank ahead of the meter is considered the better practice, the tank taking care of any slugs of water coming from the system and allowing it to flow uniformly to the meter. Water should not be allowed to back up from the discharge side of the meter, and in cases where there is some mechanical means provided for the removal of the condensate from the meter discharge, it should also be connected so as to discharge by gravity to the sewer in case of failure of the vacuum pump or return pump, as the case may be. A check valve on the sewer connection (see Fig. 7) of a vacuum return works quite satisfactorily where the vacuum is lost, the weight of the condensate opening the check and the meter discharging by gravity to the sewer until the vacuum is restored.—*From report of Committee on Meters, National District Heating Association.*

LEGAL DECISIONS

Contract Rates for Heating Abrogated by Rates Fixed by Commissioner.

The California Supreme Court holds, Law v. Railroad Commission of California, 195 Pac. 423, that a contract which entitles a consumer to heat from a public service company at rates specified in the contract, in additon to privileges given by the consumer to the ability, will be rescinded when the Railroad Commission fixes rates for heating service in excess of those fixed by the contract, but the utility can thereafter exercise the privileges granted by the contract only by paying an agreed compensation to the consumer. The consumer here complained of the order of the Commission increasing the rates for steam heating in so far as it affected his rights under his contract. His petition was dismissed. The court said in part:

"There is no longer any question as to the power of a State to fix rates for a public utility service which will supersede rates for such service previously fixed by private contract between the consumer and the company. It has been conclusively settled that the interference with private contracts by the State regulation of rates is but a legitimate effect of a valid exercise of the police power which neither impairs the obligation of a contract nor deprives of property without due process of law. It is immaterial that petitioner's contract was entered into prior to the enactment of the present Public Utilities Act and the amendment thereto by which steam heating service was included as a utility to be regulated. If the service contracted for was devoted to public use, the contract for the service was subject to the exercise of the police power, and, the State having elected to confer upon the commission the power to prescribe uniform

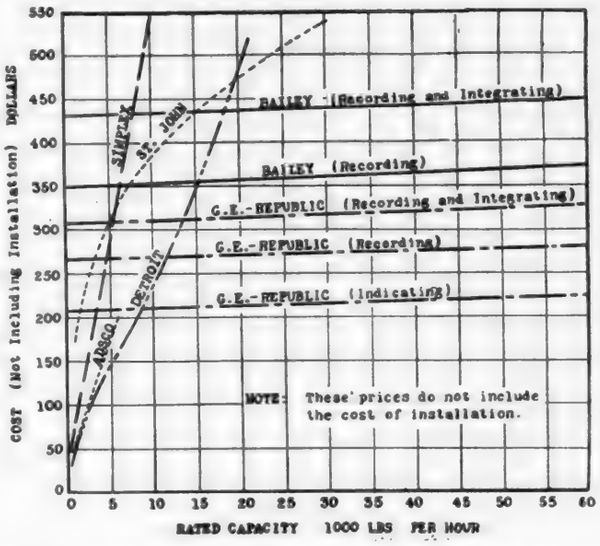


FIG. 14—COMPARISON OF CAPACITIES AND COST OF VARIOUS TYPES OF CONDENSATION METERS.

rates for the service, petitioner cannot complain if the exercise of this power results in the practical annulment of his private contract fixing compensation for a public service.

Sale of Heating Plant "in good order."

The Oregon Supreme Court holds, Williams v. Ingle, 195 Pac. 170, that where the seller of a hotel has agreed in a contract to sell the lease, with the fixtures and equipment of the hotel, that the heating plant was in good order, the purchaser, after going into possession, may elect to keep the property and recover damages although the heating plant was not in good order. Although defects in the heating plant were not discovered on the transfer of the property, where the boiler tubes were, a few weeks later, found to be exceedingly rusty, it was held that that fact was sufficient to take to the jury the question whether the plant was or was not in good order at the date of the sale.

Steam Heating Rates Increased Through Utility As a Whole Earning Reasonable Return.

The Southern Illinois Light & Power Company applied to the Illinois Commission for authority to discontinue heating service in the city of Hillsboro on the ground that owing to the changed conditions surrounding the operation of heating systems in recent years it did not seem possible to continue operation so as to derive sufficient revenue to meet operating expenses, including depreciation and pay a reasonable return on the fair value of the property, and that its heating system in Hillsboro had been in the past rendered at a financial loss. During the hearing the utility asked that increased rates be authorized should the petition for discontinuance be denied. The Commission refused the application for discontinuance, but granted the request for increased rates for steam-heating service as follows:

First 10,000 lbs. of condensation used per month, $1 per M lbs. gross.

Next 10,000 lbs of condensation used per month, 85 cents per M lbs. gross.

Over 25,000 lbs. of condensation used per month, 70 cents per M lbs. gross.

The company renders electric gas and ice service as well as steam-heating service in the city. Each class of service must be considered separately and the company was held entitled to a raise in the steam-heating rates, though the return from its operations as a whole was reasonable.

The application for cessation of heating service was made

on the assumption that the rates necessary to pay operating expenses and a fair return would be higher than the consumers could afford to pay. The evidence on the part of the consumers indicated that they were ready and willing to pay sufficient rates to permit the company to continue in operation without loss. The Commission said:

"From the standpoint of cost of the service, it is apparent that the proposed rates should be permitted to go into effect, but whether or not these rates are higher than the consumers can afford to pay is something which cannot be predetermined from this record. If the utility can continue to operate the heating utility without out-of-pocket loss it cannot be heard to complain, inasmuch as it has petitioned for authority to discontinue this system, thereby indicating its willingness to forego earning interest on the capital invested therein. On the other hand, it may be that the rates herein permitted will be higher than certain of the consumers can afford to pay, and they will install private heating plants. The loss of their business would be accompanied by a reduction in operating expenses, and in order to permit the company to continue operation without an out-of-pocket loss, further increased rates would be necessary. This would continue until the company would have no consumers, and the reason for its continuance in operation would not exist."

The rates authorized were estimated to yield a combined rate of return and depreciation on the least original cost of the property of 3.6%.

This is particularly true in the case of a coal-burning utility, the officers of which must make earnest and sustained efforts to secure coal at reasonable prices. It is believed that there might be some relaxation of such efforts if it were known that whatever price was paid would be immediately passed to the consumers. These objections, however, could not apply in this case, for the reason that the hot water heating business is but a small proportion of the total utility business of petitioner, and any failure to economize would immediately be reflected in the greater part of its operating costs, which are not covered by any service-at-cost plan.

"The evidence shows that petitioner has approximately 112,500 sq. ft. of radiation installed and that the required radiation, which is the more proper basis for computing a rate, is approximately the same. A return of 8 per cent on a value of $130,000 amounts to $10,400, and a service charge of 9 cents per sq. ft. of radiation will yield substantially that amount and will be authorized."

Water Heating Rates and Apportionment of Operation Costs.

In authorizing an increase of 15% in the water heating rates in the city of Evanston, Ill., to the Public Service Company of Northern Illinois, the Illinois Commission pointed out that when this plant was first put in operation, there was a decided advantage in the combined operation of electric and heating utilities, as the former produced steam that was available for heating purposes. The advance in the art of generating electric current has brought into use large electric generating units that yield no exhaust steam, and therefore, the advantages of combined operation have disappeared so far as the electrical utility is concerned. Electric current is now produced in large generating stations, where modern condensing machines are installed at a fraction of the cost prevailing when this plant, the Grove street, Evanston, station was built. As these modern electric plants do not yield exhaust steam, the new isolated heating plant must generate steam for the production of heating service, and therefore the cost of producing heating service has been materially increased.

A question arose as to the method of apportioning operating expenses, particularly with respect to the equity of burdening the heating utility and its consumers with increases occasioned by a saving in the cost of producing electric current. When discussing this same point in the case of the Alton Gas and Electric Company, June 29, 1917, the Illinois Commission said:

"In this particular case, the Commission is of the opinion that the development of the petitioner's heat business in the past has been such as to create the continued obligation on the part of the petitioner to serve its heat consumers, and, further, that the change in method of operating the electric and the heating plants, heretofore benefiting the electric department only, should be reflected to some extent at least by reasonable diminution in the earnings to which theoretically the heat department might otherwise be entitled. * * * It would seem not unreasonable to take a larger portion of the real cost of electricity at the heat plant as a credit to the heat expenses; i. e., average the actual cost of production at the heat plant with the cost of electricity at the new generating station and of electricity purchased from Keokuk."

Taking into consideration the circumstances surrounding the early operation of the plant, the Commission found that two-thirds of the costs incurred at the Grove street station (which the company considers as a heating plant, any electric current generated being a by-product and the value thereof a credit to the heating expenses) are properly chargeable to the heating utility.

CHATS WITH UNCLE BEN

Equilibrium.

Uncle Ben drove up to my house the other night and took me for a ride in his touring car. It was running particularly well, and I complimented him on the remarkable service he was getting out of it. Of course, this pleased the old gentleman, as his motor is his other child and he sees to it that it has the most loving care from no hand other than his own.

"I've learned a good deal from this old boat," said he, "and I sort o' think in the heating game some of the lessons I have picked up ought not to be lost. For instance, you know how carefully they have arranged that the explosive mixture shall travel the same distance and have uniform resistance in getting from the carburetor to each separate cylinder. See also how the air for cooling, entering at one end is led to each cylinder, so that the nearest one gets the most pressure, and the farthest one the least, but how the suction fan draws hardest from the cylinder most distant from the air supply and least from the cylinder nearest to the air supply. Pretty much all through this car you will see the same idea carried out, too, and by gum! I'm sold on it.

"We have two general types of gravity water heating for houses—one in which the water flows from the boiler to the various risers, the main supply reducing in size as it becomes more distant, with a return parelleling the flow, with the same size pipes at any point. The adjusting of the risers or branches is an art, and can be done beautifully, by taking off the branches, which will naturally flow easiest, from the sides of the mains, or by inserting obstructions in the easy branches until a state of equilibrium is reached. The other type is a balanced system, in which the flow lines may be the same as I have just described, but in which the return starts at the branch nearest the boiler and flows away from the boiler, clear to the end of the system, where it turns around and comes back separately. With this system of piping, of course, the water flows the same distance through all radiators in the building on its way from the boiler outlet back to the boiler inlet. It is a very nearly fool-proof system and while it costs more for material, it is open to grave question whether for ordinary use and ordinary installation it isn't the best and cheapest. You save on the item of labor in adjusting, an item which is always guessed at and which is

seldom paid for by the owner. Anyway, I have designed a great, big office building job that way lately.

"A little reaction along these lines came to me also, the other day, when I was laying out a job of drying for one of my friends. The main game in many kinds of drying, you know, is to get good distribution of the air over the product. In my friend's particular industry the custom has been to use ducts at the ceiling for distributing the air supply and just to suck it back to the conditioning apparatus through the whole room. They had a big gang of Wops who were kept employed constantly in moving the material from near the outlets to other parts of the room and vice versa, so as to secure uniform drying, and so prevent case hardening. One of the big manufacturers had worked an improvement by installing return ducts under the supply ducts, and at the floor, reducing this labor and reaping rumored great benefits from an improved process.

"It just occurred to me—why not balance the thing, give it equilibrium; and then, why not fix it so it can be reversed? In other words, bring the air to the product and avoid the bringing of the product to the air. We did just this, by starting the ceiling ducts away from the air conditioning plant in the usual way, and by starting the return ducts at the plant and running away from it to the far end, then coming back, so that the greatest pressure and the least suction were placed adjacent, also the least pressure and the greatest suction. Thus we secured an even velocity through the product which no one would be likely to disarrange.

"The milk of the cocoanut, however, is that we also arranged so that the former return ducts by a simple pneumatic switch, should become supply ducts and so that the former supply ducts should become return ducts. Thus the entire product should, by occasional reversal of the direction of air flow, be subjected to contact with the conditioned air in a manner fully as efficient, if not more so, than by the former rehandling method."

"Fine," said I, "sounds good, but nothing new. They have been drying macaroni that way for years."

"Sure," said Uncle Ben, "but they never thought to apply it to the product I'm talking about, or to do it with refrigerated air, or to do it on any such scale.

"You don't seem to want me to have any credit at all. I suppose you will spring some objection to this further equilibrium too, but you'll have to listen. I was called in on Harmony College, where the old hot water job is rotted out and they are going to put in tunnels connecting the buildings, and change to a vacuum steam system. We have the same old story in such a plant, with the greatest steam pressure on the radiators in the nearest buildings and the greatest suction from them to the vacuum pumps in the boiler-house.

"If we use electric pumps, there is no insurmountable excuse for putting them in the boiler-house. Why not put one in a building at each end of the campus, so that we have the greatest suction where we have the least pressure, and why not start the return system at the buildings nearest the boiler-house and flow away from it, letting the electric pumps shove the condensation back under pressure? The difference in cost of piping in this case is trifling. Anyhow, we are going to do it."

CONTROLLING FACTORS IN FAN DESIGN

BY DAVID DARRIN

A fan designer is generally called upon for the design, not of a fan but of a line of fans. This is due to certain fan characteristics which we shall see presently. In consequence he has certain additional points to consider beyond the requirements for any particular fan installation. As a matter of fact, the designer we are talking about would prove in practice to be plural just as is the line of fans, but whether the design is a one-man affair or the co-operative effort of a design staff, the following elements must be considered in the design process:

- Character of service to be provided.
  - Air blast for heating or ventilating.
  - Suction for ventilating.
  - Air blast for forced draft.
  - Suction for induced draft.
  - Suction for refuse removal.
- Required capacities.
  - Velocity.
  - Volume.
  - Pressure or vacuum.
  - Temperature.
  - Variation.
  - Reliability.
- Available space for installation.
  - Height.
  - Width.
  - Length.
  - Position of drive.
  - Angle of discharge.
- Mechancial problems.
  - Speeds.
  - Proportions.
  - Strength.
  - Stiffness.
  - Vibration.
  - Noise.
  - Available power.
- Available attendance.
  - Skill.
  - Frequency.
- Allowable first cost.
  - Material.
  - Labor.
  - Transporation.
- Allowable operating cost.
  - Energy cost.
  - Attendance.
  - Repairs.
- Technical information available.
- Patent rights of other manufacturers.

Each of these items has a direct and vital influence upon the success of the line of fans—and of the design staff.

CHARACTER OF SERVICE

There are two ports in a fan (at least, two kinds of ports), intake and discharge. If the fan accomplishes its purpose before intake, it is called an exhaust fan and if it does this after discharge, it is called a blast fan or a blower. It is of primary importance that the designer have fixed in mind the exact relation of the fan to the results desired, since this relation affects the fan design vitally. There are five general classes of work which take practically the entire output of medium-sized and large fans; namely, air blast heating or ventilating, suction or exhaust ventilating, air blast for forced draft in furnaces, suction for induced draft in furnaces, and suction for removal of refuse, dust, grit, shavings, or fibres, solid particles which will stay suspended in the air long enough to be removed in this way. Another application which is practically identical with that last described, is the use of suction to lift grain from boat holds.

REQUIRED CAPACITIES

Each of these general classes of service, as well as any special service which may be occasionally encountered, makes a demand on the fan for certain operating characteristics in the matter of capacity. For instance, a certain velocity is required of air which is to carry solid particles, as these settle more or less quickly in slow-moving air. For heating and ventilating service even higher velocities are not unusual, due to the fact that large volumes of air have to be delivered or withdrawn through a duct system the cross-sectional area of which is often strictly limited by structural features of the building. But when it comes to provision of an air blast for forced draft or suction for induced draft, the fan has to provide primarily a high pressure or a large pressure drop, as the case may be, while volume becomes of secondary interest and velocity of very little importance. When it is used to provide induced draft the fan also encounters another demand, that of the ability to handle very hot gases and these present problems not only of heat action on the fan parts but also of reduced density of the medium handled.

Still another practical condition which

the fan must meet is the variation in demand which is apt to occur from time to time in any of the above-mentioned classes of service. The question then arises as to how great a part of this variation the fan can be designed to meet automatically and thus meet more promptly and more economically than can be done by manual variation of speed or other operating condition. Finally, the capacity of the fan to operate continuously, in other words, its reliability, is a big design factor. The fans which supply forced draft to gas retorts have to run continuously or the retorts do not work right. The full force of this statement is best understood by the repair man who has to hunt trouble back of a conveyor which carries past a discharge of blazing coke every twenty minutes, where the iron floor of the platform blisters his feet through an inch of solid plank, where his tools soon heat up the water in which they must be frequently quenched, and where everything he touches leaves a burn. The repair man works five or ten minutes in this atmosphere and rests, or rather recuperates for twenty minutes between rounds. The fan is supposed to work there continuously, and if it does, it earns the right to be called reliable.

AVAILABLE SPACE FOR INSTALLATION.

Not only the class of service and the particular capacity requirements of this service, but also the features of the operating environment have to be considered by a fan designer. Most important perhaps is the matter of height or headroom. Frequently the fan has to go where either the ceiling or the piping or other equipment is not far above the floor level and the designer has to provide for this condition by fractional housing designs and by designs with a large ratio of wheel width to diameter. The latter design also takes care of the condition where the fan shaft has to be parallel and unusually close to a wall. Less often the fan has to set in a very narrow space and such a case would probably call for a special design. At best the variation of this ratio of wheel width to diameter is a make-shift because for any given capacity condition there is a best ratio which is better than any figure either above or below it.

The position of the drive is a matter of design interest. This is called the "hand" of the fan and is either right hand or left hand, according to its location as seen when facing the discharge port. The provision for either drive that may be desired offers no design difficulties. Some designs are made so as to be reversible in this feature. Required discharge angles also vary and these affect primarily the shape of the fan housing. Designers usually provide for either vertical or horizontal discharge from either top or bottom of fan. A complete line of fans will include also angular discharge designs and most manufacturers provide smaller sizes in adjustable housings which can be quickly set to discharge in either of several angles.

MECHANICAL PROBLEMS

The boiler designer deals largely with static problems, except in the matter of moving gases, but the mechanical problems of the fan designer are of dynamic origin. The question of speed interests him because variation of fan speed offers one of the simplest means for regulation of fan output. Another reason why speed interests the fan designer is because speed variation offers at the same time one of the easiest means for reducing fan efficiencies, since there is but one speed at which any given design will show its highest efficiency. Fan speed has other interesting features which will come to light in due course.

Fan proportions, the relation between dimensions of various parts, are important. Perhaps the most important of these ratios is the one to which reference has already been made, that between wheel width and diameter. Increasing wheel width is fruitless beyond the point where the blades work efficiently. Any part of the blade which is not working represents superfluous wheel width. The diameter of the wheel, in connection with its speed of rotation and with the angle of blade setting, determines the velocity of discharge and at the same time the diameter and speed determine the centrifugal stresses set up in the wheel by its rotary motion.

The design of the wheel from shaft to blades, as well as that of the housing, has to provide not only for sufficient strength but—a more exacting requirement—for the necessary stiffness to prevent deformations which might cause interference of parts or might alter the characteristics of the fan. Vibration must be reduced to a minimum in order to prevent loosening of bolts and rivets. The fan wheel has to possess not only static balance but also dynamic balance, so that in operation it does not pound the bearings. Not only vibration, but noise must be reduced to a minimum. The available power source affects the design in this way, that the direct-connected motor foundation is usually provided as a part of the fan housing while with belt drive there may or may not be an outboard bearing, according to whether wheel or pulley is overhung. Fan belts often work under conditions which do not conduce to highest belt efficiency. Standard practice in fan design is to include in the line of fans, designs that will fill any of these drive requirements.

AVAILABLE ATTENDANCE

Fans are commonly supposed to run without attention aside from starting and stopping and oiling, but even these operations present the invariable possibilities for trouble. The oiling problem is not entirely met by ring or chain-oiling devices—there has to be enough clean oil in the well. What was said of fan belts applies even more to fan bearings and particularly to such as may be located in the intake stream. Dust in the oil does not help in lubrication. Fans are not intended to attain full speed instantly from a state of rest. There is an art to even the simple operation of starting the fan and if it is necessary to provide manual speed regulation of a fan the process involves not only art but science. The fan designer has to recognize that few scientists attend upon fans.

ALLOWABLE FIRST COST.

In an industry as competitive and as well standardized as fan manufacture small savings in production cost loom large, and these are partly a design problem. In the matter of housing the use of sheet-iron, with angle bracing, is universal for medium and large-sized fans, while cast-iron housings are common in fans of small size. The sheet gauge is determined largely by the fan size and requirements for stiffness. If a stream of corrosive gas, or of air carrying corrosive liquid or vapor, is to pass through the fan case, a non-corroding metal must be used for housing, as well as wheel. For such heavy duty as removal of abrasive dust a more substantial construction is required for durability.

Intricacy of design is to be avoided because of the increased labor demands on production. This affects more vitally the wheel design than that of the housing, yet wheel design is the feature on which rests the largest differences in the various designs at present commercially available. Fan manufacturers—and designers as well—evidently stand united in the belief that there should be a wheel, and it is probably safe to assume that this is so. Matters of wheel design, such as the number, length, shape, pitch, and setting of blades, the size and shape of hub and spider, are still open questions which the designer has to settle with one eye on the performance curves and the other eye on the cost sheet.

Freight accommodations are fairly standard and the fan designer has to take these into consideration in connection with fan dimensions. Small and medium-sized fans can be shipped set up, but the larger sizes must be knocked down for shipment to avoid excessive charge for special car service. Door and window sizes are not very well standardized and sometimes it is necessary to knock down a fan before it can be dragged in. All of these conditions combine with the question of fan weight to influence the item of first cost.

ALLOWABLE OPERATING COST.

The principal item under the head of operating cost is the cost of power—more exactly speaking, the cost of energy. This is due to the fact that the average fan gets very little attention and to the fact that a fan is a delicate thing when trouble breaks loose and the repair item is apt to approximate either zero or the cost of a new fan. But the energy cost is a thing that can be counted on and as fans generally operate for long continuous periods the total of this cost grows correspondingly. The efficiencies of the wheel and of the bearings are the two predominating factors in power cost for a given required capacity. Since, the prospective buyer of a fan has to balance against each other the items of first cost and of operating cost, this same process is part of the function of the designer, because he has to view his design not only from a technical standpoint and from a production standpoint but also from a sales standpoint.

TECHNICAL INFORMATION AVAILABLE.

The amount of technical information available in the United States on the topic

PRESENT STANDARDS OF FAN DESIGN

Manufacturer	Trade Name of Fan	Impeller: Wheel Type: Centrifugal: Peripheral Blades: Outer Edge: Cylinder	Outer Edge: Cone	Inner Edge: Cylinder	Inner Edge: Cone	Paddle Wheel: Outer Edge: Cylinder	Paddle Wheel: Outer Edge: Cone	Comb: Outer Edge: Cylinder	Comb: Outer Edge: Cone	Propeller	Disc	Blade Features: Across Air Path: Straight	Pitched: With Rotation	Pitched: Against Rotation	Cupped	A'ong Air Path: Straight: Radial	Straight: Back Slant	Curved: Up and Front	Curved: Up and Back	Curved: Down and Back	Curved: Double D. & B. then V. & B.	Number
American Blower Co. Detroit, Mich.	"Sirocco"	×		×								×						×				64
	Type "H. S."	×		×								×							×			15
	Type "S"					×						×				×						8
American Keith Co., Inc. New York City.	"Keith" Multiblade								×			×						×				—
Autovent F. & B. Co. Chicago, Ill.	"Autovent"									×					×		×					8
Bayley Mfg. Co. Milwaukee, Wis.	"Plexiform"	×		×								×						×				32
Buckeye Blower Co. Columbus, Ohio	Mu tiblade	×		×								×						×				48
	"Buckeye" Disc										×	×					×					12
Buffalo Forge Co. Buffalo, N. Y.	"Conoidal," Type "N"		×		×							×						×				32
	"Conoidal" Type "I"	×			×							×									×	32
	"Planoidal" Type "L"					×						×				×						var
Centrifugal Fan Co. Newark, N. J.	"Four Leaf Clover"					Spe	cial								×		×					4
Clarage Fan Co. Kalamazoo, Mich.	Multiblade Type "M"	×		×								×						×				64
Connecticut Blower Co. Hartford, Conn.	"Keeney Adjustable Exhauster"					×						×				×						6
Garden City Fan Co. Chicago, Ill.	"Cycloidal Multivane"	×		×										×				×				40
	"Garden City Steel Plate"					×						×				×						8
	"Cycloidal" Low Speed						×							×		×						10
Hackney Mfg. Co. St. Paul, Minn.	"V" Blade	×		×								×							×			60
Hersh Bros. Co. Allentown, Pa.	"Lehigh" Type "M"							×				×					×	×				42
	"Lehigh" Type "S"					×						×					×					8
Howard & Morse New York City	"Blackman"									×					×		×					6
	"Duplex" Cone Fan		×		×							×							×			var
Ilg. Elec. Ventilating Co. Chicago, Ill.	"Ilg." Propeller									×					×		×					6
	Universal Blower	×		×								×						×				—
Massachusetts Blower Co. Watertown, Mass.	"Squirrel Cage" Modified	×		×								×						×				48
	Massachusetts Steel Plate					×						×				×						8
	Massachusetts Davidson									×				×	×		×					6
Monsoon Cooling System. New York City	"Monsoon"										×	×					×					var
New York Blower Co. Chicago, Ill.	"Seri-Vane" Type "C"	×		×								×						×				var
B. F. Sturtevant Co. Hyde Park, Mass.	Multivane Design 3	×		×											×			×				54
Typhoon Fan Co. New York City.	"Typhoon"										×	×					×					var
Western Blower Co. Seattle, Wash.	"Turbine" Multiblade		×		×								×					×				—
L. J. Wing Mfg. Co. New York City	"Scruplex"									×		×					×					var
	"Wing" Disc										×	×					×					6

Housing.

Housing design is so well standardized that a separate analysis for each fan is not necessary.

All centrifugal fan housings have a spiral cross-section perpendicular to the shaft and a rectangular cross-section through the shaft axis—except that small fans with cast-iron housings have a curved cross-section through the shaft axis.

Either single or double intakes are supplied—the former usually for suction and the latter for blast service. Cross-section of intake through shaft axis is in the form of a cylinder for steel plate fans and of a decreasing cone for other centrifugal types.

Full housings are standard, but a number of makers provide fractional housings, ¾ or ⅓, from stock for use where head room is small.

Propeller and disc fans have just a hoop-shaped band around the periphery of the fan or else no housing at all.

Discharge and Hand.

The standard discharges are vertical top or bottom; and horizontal top or bottom. Some makers provide stock fans designed for angular discharge. Small-sized fans designed for adjustability of discharge angle are offered by some makers.

It is standard to provide either right or left hand fans, according to order, and reversible designs are offered on some types.

Drive.

Most fan types are provided for either direct connection or belt drive, as ordered, and it is usual to have either the fan wheel or the drive pulley overhung with the preference for the former design.

NOTE.—This analysis is made from trade catalogs, and covers all the principal makes of fans. The table does not purport to include all types made by any manufacturer. Selection was made of the types which each catalog seemed to feature specially. Small fans and special service fans were purposely omitted. The analysis shows both general design practice and the marked variations from the same which distinguish some makes.

of fans, construction and operation, would probably fill a large library and might even then leave something still to be said on the subject. No designer is or can be in touch directly with all these data, but each designer needs a store of information acquired by tests on materials and designs under various operating conditions and the more complete this store and the better it has been worked up into curves and mathematical equations on performance, the better results he can get. As soon as the designer gets beyond the scope of his verified information, the ice gets thin. The designer for a large manufacturer who has been making fans and running fan tests for many years, is in touch with a large store of such technical information, but even this is apt to be along a comparatively limited path extending a little on each side of the design trail of this particular fan. If a way could be found to co-ordinate the information stores of all the fan manufacturers there might result, not necessarily any radical improvements but very possibly a number of small refinements which in the aggregate would be worth while, not only to the individual manufacturer but to the user of fans and to the community as a whole.

PATENT RIGHTS.

One delicate question leads to another. There can not be as many "best" fan designs as there are different designs now available. Quite possibly the design that is best for one purpose or capacity will not be best for some other purpose or capacity. Allowing this legitimate variation in design it seems not only possible but probable that if all fan designers were pulling together there would be greater progress in fan design than there is when each designer has to pit his patentable features against the combined features of the field. Of course these features are not combined but each exerts, never-the-less, an attractive force away from every other design. Perhaps the future will see developed a method for combining patent rights, without "restraint of trade" but rather with the resulting production and sale of even better and more fans than at present are produced and sold.

PRESENT STATUS OF OZONATION AND OZONE PRODUCING APPARATUS

A VERY satisfactory standard of ventilation is that included in a growing number of state and municipal ordinances and specified by an increasing number of consulting engineers, namely, 30 cu. ft. of fresh air per minute per person. That rate of air supply is far greater than is required to furnish the oxygen needed for breathing, but when it is considered that an air stream has the more difficult—if less vital—function of removing water vapor, odors, and possibly bacteria given off by respiration and perspiration processes, as well as the duty of providing a comfortable degree of air motion, the rate does not appear excessive. What does appear excessive is the amount of heat required to raise that air supply from outside winter temperatures to the usual indoor standard of 70° F. So, while the ventilating engineer glories in a generous supply of air to a given interior, his brother engineer in the heating line worries about the generous supply of heat incidentally supplied to the exterior atmosphere.

Out of much thought on this subject by the heating engineer, has grown the idea of recirculating this air, with perhaps a slight addition of fresh air and a corresponding slight exhaust of used air to the atmosphere on each cycle. No deep thought is required to see that this process will save heat. Of course a little additional heat will be required on each cycle to warm the fresh air addition and to reheat the used air to a required standard, but this is a very small amount compared with that required to heat a continuous stream of fresh cold air of full volume.

When it comes to recirculation, positions are reversed and, while the heating engineer glories in the saving of precious B. T. U., the ventilating engineer worries about the simultaneous saving of odors, dust, and perhaps bacteria picked up by the air stream in its path. His worrying has, in turn, produced apparatus for removing these impurities from the stream of used air before it is again supplied for human use. The two principal means for obtaining this result are by washing the air with streams of water, which cleanse it in much the same way as does a rain storm—but probably more thoroughly—, and by injecting into the air a stream of ozone which releases nascent oxygen and

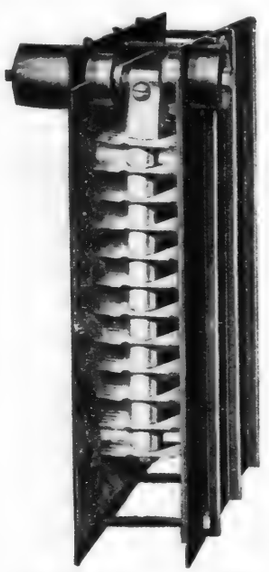


FIG. 1—ELECTROZONE ALL-STEEL UNIT

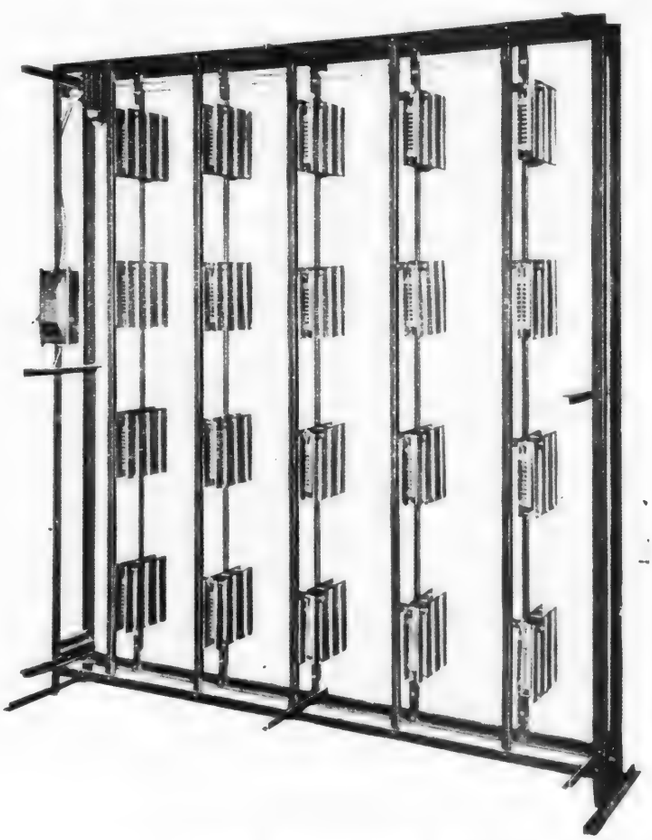


FIG. 2—20-UNIT ELECTROZONE ASSEMBLY

literally burns up all oxidizable impurities in exactly the same way—but much more rapidly—that oxygen in the atmosphere burns up oxidizable material through decay, rusting, and tarnishing. While the devices involved in these two methods are different in nearly every other respect, they are alike in that both are effective for the purpose in view. The air-washer has established its position in air conditioning work. The ozonator, although not a new device or discovery, has yet to find a wide field of application. It might be hard to explain this fact, but its truth is very easy to check by noting that at present there are less than half a dozen makes of ozonator commercially available.

COMMERCIAL APPARATUS.

Just as commerce has imitated Nature in the production of the air-washer, so the imitation continues in respect to ozonation, for all of the ozonators now on the market produce ozone by the electrical discharge method. So it takes no large amount of imagination to picture the combination of an air-washer with an ozonator as producing, within a restricted indoor area, a veritable little thunderstorm. However, the discharge found best for purposes of ozonation is the soft continuous glow known as a brush discharge and it is this effect, rather than the brilliant, snapping, intermittent spark discharge,

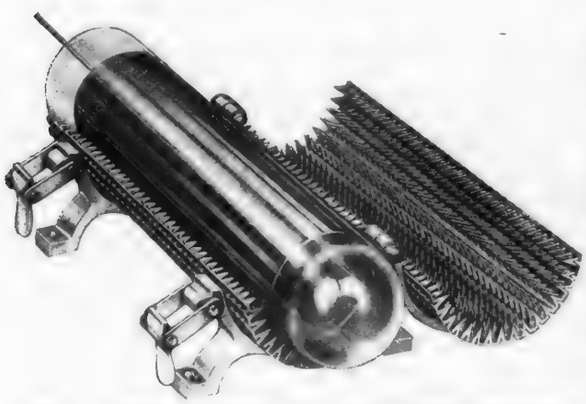


FIG. 3—PURE AIRIFIER UNIT OZONATOR, SHOWING CONSTRUCTION

which is found in commercial ozonators. While the structural details vary considerably, the fundamental principle is the same in all four makes.

The Electrozone all-steel unit, manufactured by the Air Conditioning & Engineering Co., St. Louis, Mo., is shown in Fig. 1. The central electrode is formed of twelve flat steel plates resembling double-edged combs which extend horizontally from front to back of the unit and are assembled in a vertical column, the whole thing being strongly reminiscent of a curry-comb. Two flat steel plates, parallel in position and electrically connected, enclose the toothed assembly and form the opposite electrode. A space between the points of the teeth and the flat plate permits the insertion of a flat plate of special material on each side of the comb and this forms the dielectric. This unit is quite open to the air and can be assembled or disassembled quickly and easily.

Fig. 2 shows a twenty-unit assembly adapted for air-conditioning on a large scale. The units are supported on a rigid steel frame so designed that any unit can be removed for inspection or repairs with minimum effort. An air-cooled transformer, mounted in the upper left-hand corner of the frame, serves to step up the voltage to the required operating value.

OZONE PURE AIRIFIER DESIGN.

In the unit manufactured by the Ozone Pure-Airifier Co., Chicago, Ill., shown in Fig. 3 the electrodes are made of aluminum instead of steel and the general scheme becomes cylindrical, instead of flat. A smooth interior electrode of aluminum foil slips snugly into a cylinder of Pyrex glass which forms the diaelectric. The exterior electrode consists of a sheet of aluminum expanded to form a number of small points. This sheet is then bent to a semi-circular section with the points in and when in position these points rest against the outside of the glass cylinder. Two of these semi-circular sections hinged together enclose the glass cylinder completely and a simple clamping device holds them together or permits easy disassembing of the unit for cleaning or replacing any part.

A twenty-five-unit assembly, adapted for use in connection with air conditioning work, is shown in Fig. 4. These units are mounted on an angle-iron frame of rugged construction which carries also the switch, control rheostat, two fuses, and a step-up transformer for providing the required voltage. Power consumption of 120 watts at full load is claimed for this outfit by the maker.

SPRAGUE OZONATOR DESIGN.

Fig. 5 shows the design characteristics of the unit made by the Sprague Electric Works, New York. This type also uses the cylindrical construction but, instead of a toothed outer electrode, there is a smooth sheet of foil wrapped around the glass cylinder. As a matter of fact, however, this amounts to practically the same thing because, viewed under the microscope, the apparently smooth surface of the foil is seen to present a series of irregular projections which act as teeth in the concentration of electric charges.

The Sprague industrial ozonator is shown in Fig. 6. This arrangement brings the units closer together than in the other large capacity assemblies above described. Also it protects the units from too direct contact with the air stream and this undoubtedly serves as an extra insurance against over-ozonation.

FIG. 4—25-UNIT PURE AIRIFIER OZONATOR

REGULATION.

The principal thing to be guarded against in operation of an ozonator is too rapid production or too great a degree of ozonation. Improperly operated, an electric discharge ozonator produces, along with the ozone, another gas called nitrogen peroxide which is both malodorous and poisonous, and the presence of which obviously defeats the purpose of the apparatus. All of the above makes reduce this hazard by designing for the brush discharge, instead of the spark discharge, and by providing for manual regulation of the rate of ozone production. The nose is the most sensitive instrument available for the detection of this fault and when the apparatus is operated so that there is no perceptible odor, the operator can be certain that no poisonous gas is being evolved. Because the rate of air delivery in most systems is likely to be fairly constant over considerable periods, there is little need for variation of the

rate of ozone production after the proper average rate has been determined for a given rate of air flow.

COST.

The catalogs of the above manufacturers vary somewhat in their approach to the subjects of capacities and operating costs. The assembly shown in Fig. 6 is designed

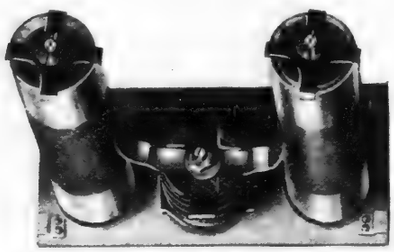


FIG. 5—SPRAGUE OZONATOR UNIT

to handle proper ozonation of 25,000 cu. ft. of air per minute on 120 watts. At 10c per Kw.hr. this reaches the grand total of 12c for a 10-hour day. The unit shown in Fig. 5 is rated at 87.5 milligrams of ozone per hour per cylinder on a power consumption of about 9.5 watts per cylinder. The rate of air flow which this

INSTALLATION.

Each of the above manufacturers puts out portable units designed for use resembling the service required of a portable electric fan, but the present article must be confined to the application of ozonation to large scale air-conditioning work. Because the operation of the ozonator will be seriously affected by the presence of either excessive quantities of dust or excessive water vapor content, the natural place for the ozonator in an air conditioning plant is between the air-washer and the humidifier.

LOOKING AHEAD.

It was stated that an explanation of why ozonation has never achieved its rightful popularity and application might be difficult. However, this explanation will be attempted. In the first place, the most obvious way to clean anything is to wash it and by its name as well as its function the air-washer has an edge on the other device. Second, the ozonator can be so operated as to produce results that are both unpleasant and dangerous. Early experiments produced these results and gave the method a bad name before it could build a good name by its virtues. It

device first and then the special device for refinement. Fourth, the ozonator is particularly suited for conditioning air for human use and this has been less well developed commercially than air conditioning for industrial purposes. These effects have combined to retard the commercial development of ozonation and ozone apparatus.

Eventually the more important branch of conditioning air for human use will achieve the development which it deserves and with this will surely grow the application of ozonation methods and apparatus. The movement has started in respect to such structures as schools, theatres, auditoriums and other assembly interiors and ozonation has already proved its capacity for satisfactory and continuous results. From this time on, the rate of development may reasonably be expected to show continual increase.

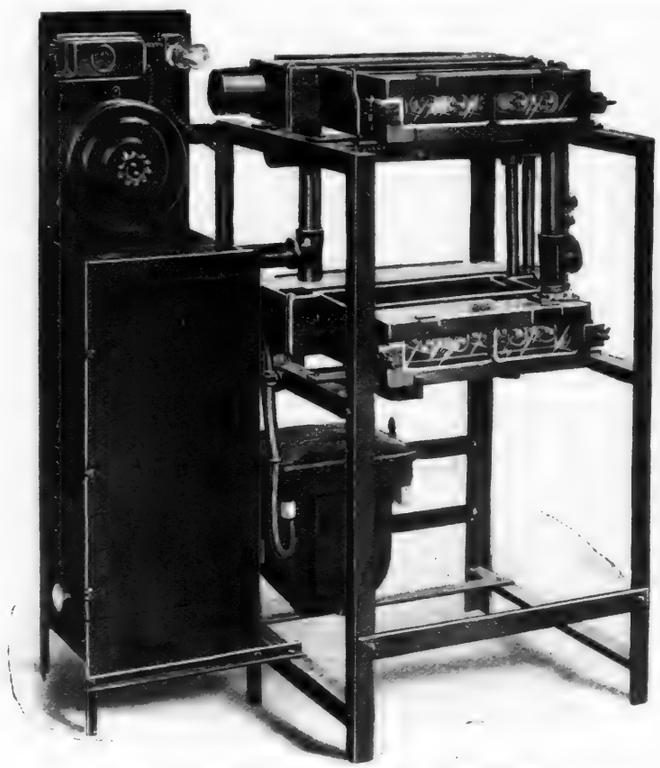


FIG. 6—SPRAGUE INDUSTRIAL OZONATOR

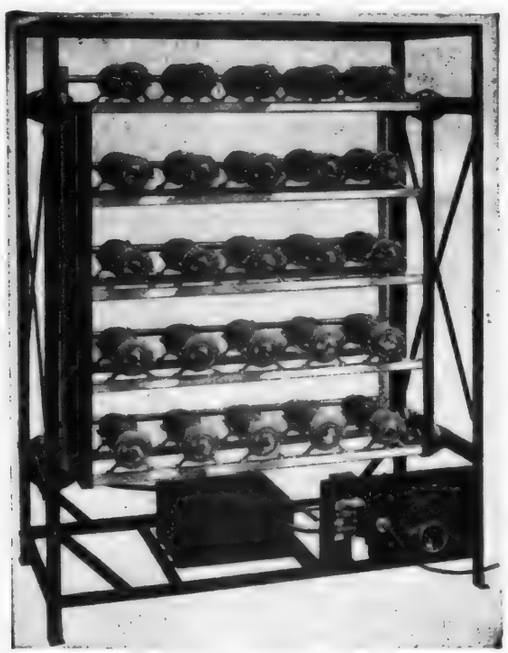


FIG. 7—ASSEMBLY OF THE OZONE COMPANY OF AMERICA'S UNITS

will properly ozonize is not given, probably because that depends upon the condition of the air in any particular case. From the unit shown in Fig. 1 is claimed proper ozonation at about the cost of operating an incandescent lamp. The cost of operating the unit shown in Fig. 8 is compared with that of running a small electric fan. Obviously these estimates baffle comparison, but even the least optimistic claim serves to indicate a remarkably small operating expense.

is not so easy to get the same kind of bad results by over-working an air-washer. Third, the two devices are not really competitors. The proper function of the ozonator is to supplement the function of the air washer which is most effective in removing dust and other impurities of comparatively large size, while the ozonator is most effective in attacking impurities in comparatively minute sizes and in the gaseous form. Thus the natural sequence of adoption would be the general utility

Evening Courses in Heating and Plumbing.

The New York City Board of Education calls attention in a special notice to the fact that free instruction is offered in its Evening School System to both men and women in over 200 trade and vocational courses, including the following:

1. Plan Reading.—Blue-print Reading.
2. Plumbing.—Steam Fitting.
3. Sheet Metal Work.
4. Steam Engineering.

Course No. 1 is offered at the Murray Hill Evening Trade School, Stuyvesant Evening Trade School, Brooklyn Evening Technical and Trade School, Bushwick Evening Trade School and Harlem Evening Trade School.

Course No. 2 is taught at Murray Hill Evening Trade School, Stuyvesant Evening Trade School, Brooklyn Evening

Technical and Trade School, Bushwick Evening Trade School, Harlem Evening Trade School, Tottenville Evening Trade School, Long Island City Evening High and Trade School, and Evening Schools 95, 5 and 126.

Course No. 3 is offered at Murray Hill Evening Trade School, Bushwick Evening Trade School, Harlem Evening Trade School, Seward Park Evening High and Trade School, and Evening School 95, Manhattan.

Course No. 4 on steam engineering is offered at Murray Hill Evening Trade School, Stuyvesant Evening Trade School, Brooklyn Evening Technical and Trade School, Harlem Evening Trade School, and Evening School 67, Manhattan.

All of the courses mentioned are open to those now employed in some branch of the industry and the instruction given is supplementary to day-time occupations, the aim being to fit the individual for greater earning capacity.

For fuller information, application should be made to the nearest Evening Trade School mentioned, or to Morris E. Siegel, director of Evening and Continuation Schools, 500 Park Avenue, New York.

Favors the Down-Draft Principle of Combustion.

Further arguments in the discussion of down-draft versus up-draft for smokeless boilers, this time favoring the down-draft principle, have been received from the John O'Brien Boiler Works Company, through James A. McKeown, president.

"Before adopting the down-draft boiler," states the company, "we did a great deal of experimenting, ran many tests and did considerable research work, after which we concluded that the down-draft boiler is the most economic hand-fired furnace that has ever been perfected. You also understand that we make straight-draft boilers, but only where the smoke ordinance is not in effect.

"We believe that there is a tendency among some manufacturers of heating boilers to change their design by admitting air over the fire. This is an old idea and while it prevents some of the smoke it is at the expense of economy. The admission of cold air over the fire reduces the percentage of CO_2, hence reduces the efficiency of the boiler.

"When the air is heated before entering the furnace the B. T. U. required to preheat this air is taken from the furnace which would otherwise be absorbed by the boiler.

"We are frequently obliged to make a combined furnace and boiler guarantee of from 72% to 74% economy using Illinois Coal containing 10,500 B. T. U. and to guarantee to eliminate 95% of all smoke and we feel confident that this guarantee could not be met with a straight type of furnace.

"We make no boiler of a size that can be used for heating houses, but for apartments and larger buildings our horizontal tubular and down draft furnaces are used and many of these are operated by the janitor."

Wholesale Wage Cut in Chicago Building Trades.

On September 7 was announced the decision of Judge K. M. Landis, umpire in the Chicago building trade wage conference, in which are made deep cuts in the hourly rates of all workers in the building trades of that city. The accompanying table shows a comparison between the old scale of wages and the Landis scale which was scheduled to take effect at once and remain in force until May 31, 1922.

Two points brought out by Judge Landis in the course of his investigation of the building industry, preliminary to the fixing of the new wage scale, are worthy of thoughtful attention. The first of these is the fact, announced by this arbitrator, that a 20% reduction in wages would have produced only a 6 to 7% reduction in the cost of building. This seems to mean that a large share of the loss to the wage earners would be absorbed by the contractors so that the benefit to the general public would be quite small. The second point of special importance made by Judge Landis, concerns a situation which was outside the scope of his functions as arbitrator, but well within the range of his caustic comment. No improvement can be made upon his own words summarizing the conditions in the building materials field, as follows:

"In conclusion a word about the building material situation. This is intimately and directly involved in the question with which we have been struggling. The testimony before the Dailey committee disclosed that a very large proportion of all building material is subject to artificial control. In utter contempt of State and Federal Penal Codes, firms and corporations controlling the various lines have associated themselves together to fix and maintain prices. Business is divided up among the members of these associations and adherence to the allotments is enforced by penalties, reimbursements and other devices denounced by the criminal law. This atrocious situation is beyond the reach of the umpire, but the activities of grand juries and prosecuting officers give me faith that real war is being waged against this species of criminality."

Relying upon the reputation of Judge Landis for square dealing, most of the unions agreed in advance to abide by his findings in this dispute. Several unions, including the carpenters, painters, plasterers, and sheet metal workers, refused to accept these findings in advance or to conform to rulings made in connection with the wage award and these unions are now fighting the reductions as far as their own trades are concerned. As to the position taken by the building trades as a whole, reports conflict, some indicating a tendency to attempt compliance with the ruling in spite of the heavy cut in wages, while other reports seem to point toward a protracted struggle to maintain the old rates. Should this uncertainty crystallize into an effort at resistance, the unions are threatened with a reversion to the open shop method of operation.

TABLE 1—EFFECT OF LANDIS DECISION ON WAGE RATES IN CHICAGO BUILDING TRADES.

Trade	Old Rate per hour	Reduction per hour	New Rate per hour
Cement finishers	$1.25	$ .40	$ .85
Electricians	1.25	.15	1.10
Hod Carriers	1.00	.27½	.72½
Laborers	1.00	.27½	.72½
Lathers	1.25	.25	1.00
Plasterer's tender	1.06½	.27¾	.78¾
Bricklayers	1.25	.15	1.10
Gas fitters	1.25	.30	.95
Hoisting engineers	1.25	.40	.85
Marble setters	1.25	.37½	.87½
Ornamental iron workers	1.25	.30	.95
Pipe coverers	1.25	.30	.95
Plumbers	1.25	.30	.95
Steam fitters	1.25	.30	.95
Stone cutters	1.25	.22½	1.02½
Structural iron workers	1.25	.20	1.05
Tile setters	1.25	.22½	1.02½

Current Heating and Ventilating Literature.

Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the article mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

MEASUREMENT OF DUSTINESS.

The Shinizu-Wilson Cloud-Condensation Apparatus. Elecn., vol. 86, no. 2247, June 10, 1921, pp. 720, 2 figs. Apparatus for measuring dustiness of atmosphere. Modifications of Wilson cloud-condensation apparatus. 30 c.

HUMIDIFYING APPARATUS.

Humidifying Apparatus for Textile Factories. Engineer, vol. 131, no. 3416, June 17, 1921, pp. 648, 3 figs. Cleworth-Wheal air-humidifying apparatus. 30 c.

COAL VS. OIL FUEL.

Relative Efficiencies with Coal and Fuel Oil, A. W. Darter. Power Plant Eng., vol. 25, no. 13, July 1, 1921, p. 657. Comparative boiler tests with Texas lignite and with Mexican fuel oil. 30 c.

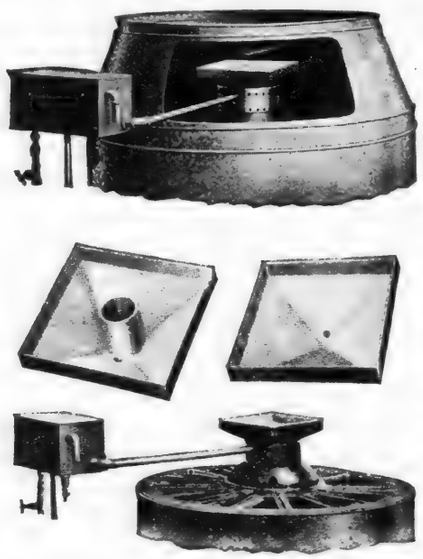
STEAM FLOW IN PIPES.

Handy Steam Velocity and Steam Flow Tables, V. F. Davis. Mar. Eng. vol. 26, no. 7, July 1921, pp. 522. Capacities of steam pipes in pounds per minute with steam-flow velocity of 6000 ft. per min. 30 c.

HUMIDIFYING DEVICES FOR THE HOME

No. 13—Kelsey Automatic Humidifier.

Humidification of warm air in the Kelsey warm-air generator is effected by means of an automatic humidifier which rests centrally just above the dome of the heater. The water pan is of pyramidal shape with the apex inverted so that the exposed surface of the water varies with its depth in the pan. This evaporating pan is supplied from a storage tank without the heater casing and this tank is equipped with both supply and over-flow connections so that a constant water level may be maintained. When it is desired to secure still greater humidification, the Kelsey water evaporating pan can be installed. This pan rests in an iron frame which can be bolted to the heater casing, and the pan is so designed that it tips outward when it is to be refilled. These humidifying devices are made by the Kelsey Heating Company, Syracuse, N. Y.



ARRANGEMENT OF KELSEY HUMIDIFIER FOR WARM AIR FURNACES

No. 14—Front Rank Automatic Air Humidifier.

The accompanying illustration shows the Front Rank automatic valve humidifier as applied to a warm air furnace, but there is nothing about the construction or operation of this humidifier which limits it to that single application. In fact, the device might be applied in any place that humidification is achieved by evaporation of water from a fixed container.

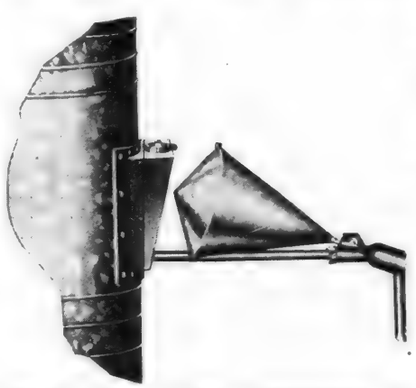
With this humidifier, made by the Haynes-Langenberg Mfg. Co., St. Louis, Mo., there is nothing radically new in the humidification process. The feature of the apparatus is the automatic valve by which is insured a continuous supply of water from the domestic supply lines to the evaporating pan, without manual control. This valve consists of a conical tank at one end of the valve handle, balanced by a counterweight at the other end. When the water pan is empty the conical tank is upright (or nearly so—it must be a little vertical to give an operating leverage) and the valve is open. Water flowing into the water pan also enters the conical tank until a point is reached where its weight overbalances the counterweight, when it tips over to a position neary horizontal (with enough slope to permit draining of the conical tank into the water pan), in which position the valve is closed. As water is evaporated from the water pan the level in this pan and in the conical tank gradually falls until the counterweight again acts to return the valve to its initial position and the cycle is repeated.

FRONT RANK VALVE HUMIDIFIER ATTACHED TO TOP OF CASING OF WARM AIR FURNACE.

No. 15—Trico Humidifying Shield.

A radiator cover which combines in one piece of apparatus the functions of three is the Trico humidifying shield manufactured by the Art Metal Radiator Cover Co., Chicago, Ill. This device is well named. Besides acting as a radiator shield and humidifier it also serves as a seat or shelf and in these days of microscopic apartments an extra seat or shelf is bound to be welcome. The design of the humidifying feature deserves special attention, embodying as it does points which are distinctive to this make of humidifier. Into the top of the shield is fitted a flat rectangular water pan and over this is fitted a metal cover provided with a flap or hinged metal section which can be raised for the purpose of filling the water pan. By means of this metal cover over the water pan is prevented excessive evaporation beyond the humidity requirements of the room and in this way the frequency of filling is also reduced—another advantage from the housekeeper's point of view.

TRICO HUMIDIFYING RADIATOR SHIELD



FRONT RANK VALVE HUMIDIFIER ATTACHED TO FURNACE WATER PAN

Newark, N. J.—As the result of arbitration between the employers and workmen a new wage scale has gone into effect in Newark, as follows: Masons, $10.00 per day as formerly; steam fitters, $9.00 instead of $10.00; sheet-metal workers, $9.00 a day instead of $10.00; iron workers, $8.00 per day instead of $9.00; laborers, $5.76 per day instead of $7.00; hoisting engineers, $10.00 by the half-day, instead of $55.00 per week; plumbers, (by mutual agreement) $9.00 per day instead of $10.00. Since all of these trades have been settled, the carpenters have asked for an increase from $8.00 to $9.00 per day. This matter is now under arbitration.

Associated Commercial Engineers, 96 Fifth Ave., New York, recently organized by Courtney Rothwell and M. William Ehrlich, have been appointed New York representative for The Trane Company. They will handle the Trane specialties and pumps exclusively in the metropolitan district.

Characteristics of the NoKol Automatic Oil Burner.

By G. Dec. May

The NoKol automatic oil burner, made by the Steam Corporation, a division of the Amalgamated Machinery Corporation of Chicago, is an oil burner somewhat different from the general run of oil burners on the market today. There is no pressure used, no pre-heating of the oil, and no possibility of poor combustion due to ignorance of the operator or owner. The amount of oil burned is automatically proportionate to the amount of air used, and the amount of air is determined by the service man at the time of installation, to fit the particular load on the boiler.

A NoKol outfit consists of a small electric moter driving a direct connected blower, a venturi in which is mounted a fuel nozzle, a combustion chamber, a float chamber to maintain the proper level of oil in the fuel pipe, safety devices, which I shall describe later, and a suitable means for starting and stopping automatically from thermostatic demands. All these components are recognized devices of long standing, and have been incorporated into a harmonious and efficient design of a complete burner.

OPERATION.

The motor is of standard type, furnished in direct or alternating current as the installation may require. The air furnished by the blower passes through a pipe carrying at its end opposite the blower a venturi, and this in turn carries a fuel nozzle. The air passing through the venturi and nozzle aspirates the oil held normally by the float chamber at a point 3 9/16 in. below this nozzle, and sprays it in a finely distributed mist, into the combustion chamber. The combustion chamber is made of a casting, about square in shape, but so designed that it causes the flame to wrap about itself, and thereby complete combustion. Ignition is provided by means of a gas pilot-flame, which is automatically turned higher momentarily as the blower motor starts, to provide sure ignition.

SAFETY DEVICES.

The fuel feed assembly consists of a valve, a strainer, and a float chamber, and oil from the supply tank is fed by gravity to the float chamber, at which point it is held at the proper level by the float. Should dirt pass the fine mesh screen and lodge under the float valve, causing it to remain open, the float chamber is provided with an overflow pipe, which leads to a safety bucket suspended on an arm connected to the safety switch and the fuel valve mentioned above. The filling of this safety bucket two-thirds full of oil causes it to drop, opening a quick-break switch in the blower motor circuit, and shutting off the flow of oil at the fuel valve. The machine is then inert until the bucket is emptied by hand, and the safety switch re-set. Failure of ignition, due to the gas pilot-light being out at the time of the starting of the burner, will result in the oil mist collecting in liquid form in the combustion chamber, running out through a drain pipe and trap to the same safety bucket, and the shutting off of the burner in the same manner.

REGULATOR ACTION.

The starting and stopping operations proceed as follows: The dropping of the temperature of the room in which the thermostat is installed to a point below which it is set causes the thermostat to make a contact (of low voltage current furnished by a small transformer) which starts the regulator. This regulator is merely a small motor driving a shaft through a train of reduction gears, the shaft having on one end the blower motor contact, and on the other a coupling to the gas valve, in order to open the pilot when the blower motor starts. The thermostat connection starts this motor (which runs on 110 volts) which then makes a half revolution of the driven shaft, at which point a cam action breaks the contact and stops it, and the blower motor contact is left on. The pilot-light has been expanded and has returned to normal during this cycle. The burner then continues in operation until the room temperature rises to a point which causes the thermostat to make contact on its other side, when the regulator again makes a half-turn of the driven shaft, this time stopping with the blower motor circuit open. The stoppage of the blower motor necessarily stops the flow of oil, as it is the action of the air furnished by the blower that raises the oil the 3 9/16 in. noted previously.

CONTROL.

Control of the size of the flame, and of oil consumption, is secured by varying the amount of air admitted to the blower. This is controlled by a set opening, which is selected after the load on the boiler has been determined, or in the case of a hot air furnace, after the heat demand of the house has been determined. The amount of oil, then, cannot be varied by the owner, and the result is that proper combustion is always obtained. We have found the amount of "throttling" that can be done on an oil burner (and at the same time keep proper combustion) is only a very small percentage of its rating. We therefore do not attempt to throttle the burner as the house temperature rises, but at a point predetermined by the owner (the thermostat setting, varied at will) shut it off completely, and when the temperature drops two degrees, start it up again. This intermittent feature takes care of varying outside temperatures, as the setting of the burner is made for continuous operation at 0° F. outside and 70 inside temperatures. A thermostat may be set at 70 degrees in the beginning of the heating season, and the temperature will automatically be held at that continuously. So much for the mechanical features of NoKol—except that it may be noted here that the burner as a whole has the approval of the National Board of Underwriters.

INSTALLATION.

The installation of a NoKol merely requires the removal of the grates of the boiler or furnace, and the removal of the ash pit door. The burner is then placed with its combustion chamber on the former grate line, and the ash pit door opening around the burner pipes sealed with brick or asbestos cement reinforced with wire mesh. The tank is connected by ⅜" pipe to the burner, and the necessary electric connection for the blower motor, gas to the pilot light, and installation of the thermostat completes the job.

CONSUMPTION, COST, AND EFFICIENCY.

A comparison of oil consumption of NoKol with coal brings out the fact that between 87 and 100 gal. of oil are equivalent to a ton of anthracite coal. This figure, which we call 100 in round numbers, has been arrived at both by actual test and by calculation, and has repeatedly been checked. A figure of 167 to 185 gal. to a ton has frequently been quoted by various authorities, but it will be found that this refers to power plant work, where coal fired boilers are giving a high percentage of efficiency—much higher than we can possibly obtain under the conditions to which a house heating boiler is subject. NoKol will actually burn about 100 gal. of oil to the ton of anthracite coal.

On this basis, it will be readily seen that oil in cents per gallon is equivalent to coal in dollars per ton for fuel delivered in the basement. With NoKol there is no ash removal cost, and all the oil is burned efficiently. With regard to efficiency, it may be noted that the average NoKol installation shows from 14 to 14.8 CO_2, which is about 98% burner efficiency.

OIL GRADES AND STORAGE.

The oil used, for satisfactory automatic operation, must conform to the following specifications: Flash point, not lower than that of kerosene (this is an insurance requirement); Fire point, not over 225° F; Viscosity, not exceeding 55 Saybolt; Gravity, not heavier than 28-30 Baume. A large range of distillates, gas oils, and light fuel oils are included in these specifications, and while lower grade oils may be used; they will not give satisfactory automatic lighting. The oil must obviously be free flowing, as it is not preheated, nor subject to pressure.

Storage of oil must conform to local ordinances. For example, here in Chicago our oils may be stored in the basement in approval tanks in quantity not exceeding 55 gal. Additional supply, which is obviously desirable, is carried in a tank buried below ground, and pumped to the smaller tank as occasion requires

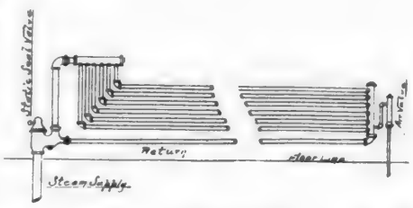
New Apparatus and Appliances

Packless Static Seal Steam Radiator Valve.

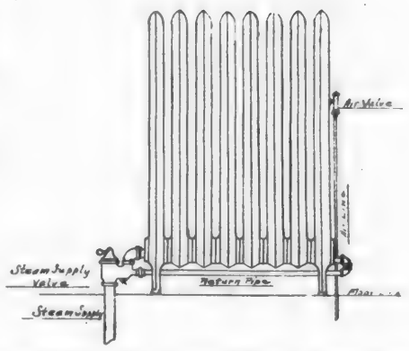
An interesting type of radiator valve, adaptable to old or new gravity or air-line steam heating systems, has been developed by E. H. Murphy, 219 Hale St., Charleston, W. Va., and is shown in the accompanying illustrations. It is described as a positive opened or closed valve and cannot stop at any intermediate point.

The first type of valve shown is adapted for use on water type of radiators or wall coils and has supply connection and control at the top and return connection at bottom for radiator or coil. The second type shown has control and return at bottom and is adapted to supply at either top or bottom of radiator or coil.

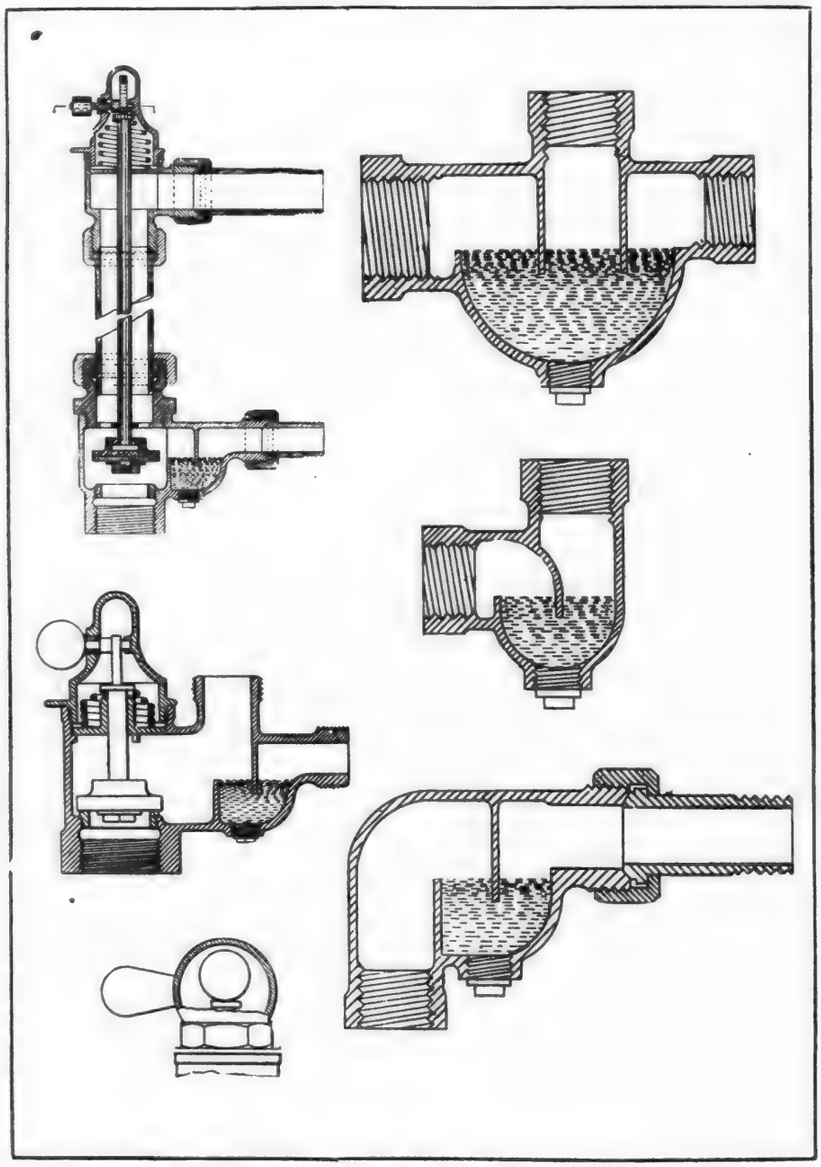
It is stated that it is possible with this valve to use radiators or coils of any length or size with equally good results in both gravity and vacuum air-line systems. The return is carried to a constantly balanced liquid seal located within the valve body from which the condensation overflows into the steam supply pipe.



METHOD OF CONNECTING PACKLESS STATIC SEAL VALVE TO COIL.



METHOD OF CONNECTING PACKLESS STATIC SEAL VALVE TO RADIATOR

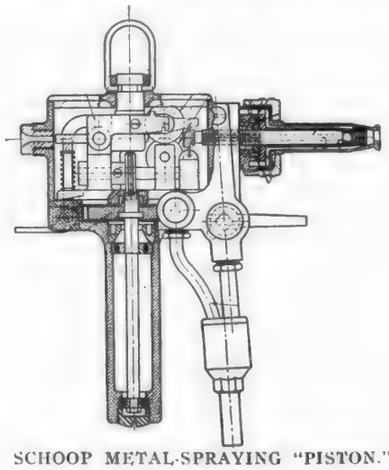


DESIGN OF PACKLESS STATIC SEAL STEAM RADIATOR VALVE

An Air-Brush for Spraying Metal.

This is one way to describe the "pistol" used in the Schoop metal-spraying process controlled by the Metals Coating Company of America, Philadelphia, Pa. Another way to describe it is as a machine gun making its ammunition from reeled wire and coating objects by bombarding them with minute plastic particles of metal.

In brief the device consists of a portable apparatus in which is contained a mechanism for feeding the wire from the reel through the "gun," along with means for producing an oxy-hydrogen, or oxy-acetylene flame. This flame is brought to a focus on the tip of the wire at the muzzle of the device and serves the double function of melting the metal and of projecting it in a finely-divided state and at high speed against the surface to be coated. By supplying an excess of hydrogen or acetylene gas to the pistol, the flame is made reducing so that no oxidation can occur in the spraying process. The bond secured between the surface and the coating metals is a mechanical one, the plastic coating metal flowing into surface depressions and locking itself in much the same way as does plaster on a wall.



SCHOOP METAL-SPRAYING "PISTON."

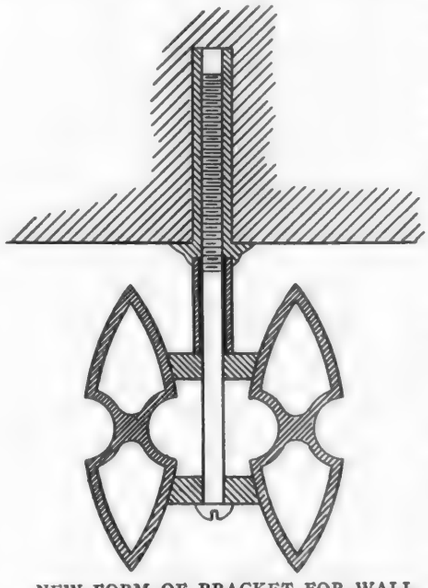
While the temperature at the focus of the flame is high enough to melt the most

refractory metals, it is claimed by the manufacturers that the spray is cool enough so that paper can be coated without charring, although the muzzle is held but five or six inches from the surface to be coated. Means for adjusting the supplies of hydrogen and of oxygen and for regulating the speed with which metal is fed, provide a considerable range of possible variation to meet the needs of various services.

The most obvious value of the process is for applying protective coatings to parts which are already assembled or for some other reason can not be coated by dipping or electrolytic processes.

A Simple but Sturdy Radiator Bracket

Patent has been secured by Harry Pickup, London, England, on a new form of bracket for suspension of wall-type radiation. There are five parts to the bracket, including the socket which is fixed in the wall. To suspend the



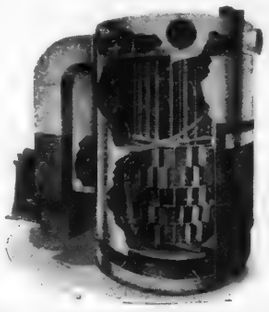
NEW FORM OF BRACKET FOR WALL RADIATORS.

radiator a screw bolt is passed through two wedges, or snugs, fitting on opposite sides of the radiator between adjacent sections. A tubular distance piece is then slipped on the bolt and the latter is then threaded into the socket in the wall. The bracket is quite inconspicuous when in place and the socket is practically unnoticeable, in case the radiation should be removed.

The Gordon Mechanical Hot Blast Heater.

In the Gordon mechanical hot blast heater, manufactured by Robert Gordon, Inc., Chicago, Ill., is found the combination of a hot air furnace and a blast fan, arranged to do duty as a unit heater. As far as the external appearance of the furnace portion is concerned, there is no great deviation from standard and the main feature of its internal construction is the provision of protruding metal fins, around the fire-box and the internal exhaust flues, which serve to increase the area of hot metal and at the same time impede the flow of air so that there is opportunity for thorough heat transfer.

The air supply enters this heater near the floor and passes over the heating



DESIGN OF GORDON MECHANICAL AIR BLAST HEATER.

surfaces above described, then entering the fan from which it is discharged back again to a compartment that might be called the super-heater at the top of the furnace. From this compartment run pipes to the various locations to be heated. When used as a unit heater there are no pipes required, since the warm air can pass out through the tubes provided for pipe connections.

Grates of the revolving shell bar type are furnished with this unit and featured in the maker's literature. These have three wearing surfaces and operate in pairs in either direction. When revolved these grates act so as to crush and dump cinders and clinkers which might jam in a shaking grate.

De-Aerating Apparatus for Preventing Pipe Corrosion.

The action of water upon the interior surfaces of pipes is never in the direction of benefit to the pipes, or the water, or any of the equipment that may be connected into such piping systems. When the water is hot this action results in even less benefit, since the heat expedites the corrosive process and causes more rapid circulation than would be experienced otherwise. This difficulty is not confined to water which may contain acid or alkaline substances, but is experienced in connection with pure water, due to the fact that it has the power of absorbing air-containing oxygen which is released inside the pipes and attacks the metal of the pipes, producing rust.

Cold water has less power to absorb air than warm water, but when water is heated to within a few degrees of its steaming temperature it again reaches a condition where it readily yields up its store of dissolved air and when thus de-aerated it does not have the same corrosive action on pipes in which it is contained. This fact is the basis of the de-aerating apparatus made by the Anti-Corrosion Engineering Co., of New York, and illustrated herewith.

The deactivator is constructed in three

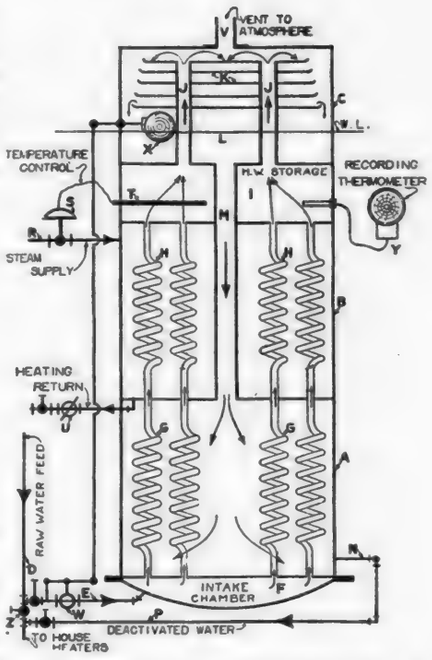


FIG. 1—TYPICAL ARRANGEMENT OF DEACTIVATOR FOR PREVENTING PIPE CORROSION.

sections, A B and C, bolted together to form one unit. A is an exchanger, B is a booster heater, using low-pressure steam, and C is a de-aerator. The shells are 5/16 in. open hearth steel, sections A and C being coated inside with the finest grade of porcelain enamel. The coils, pipes, pans, stay-rods and diaphragms are of cold rolled copper or Tobin bronze, making for stability and long life; in fact all working parts exposed to water contact are practically corrosion-proof.

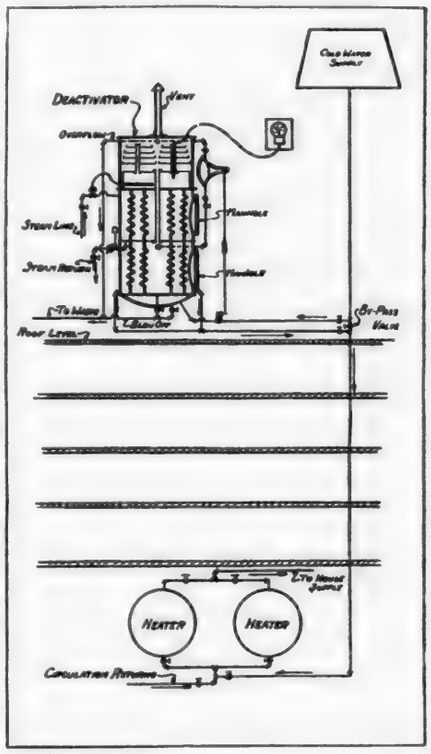


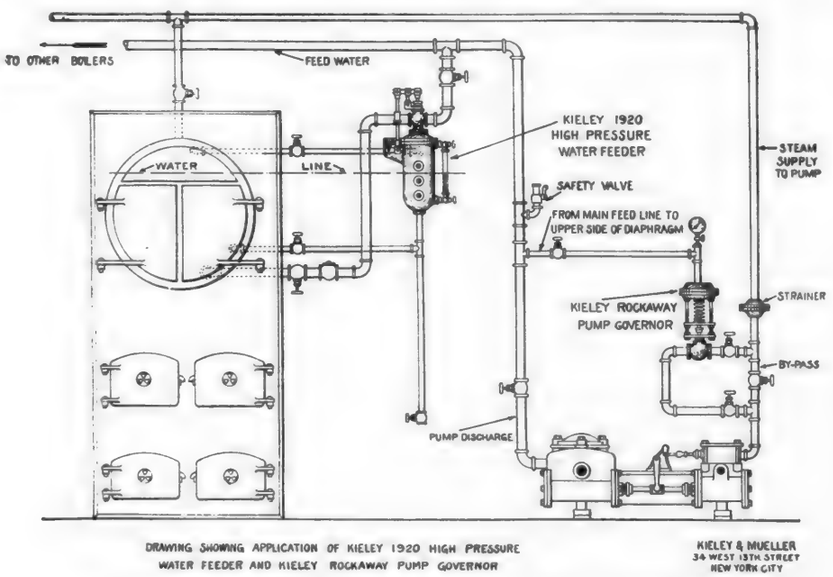
FIG. 2—DIAGRAM OF CONNECTIONS TO DEACTIVATOR.

The water which would normally pass directly down pipe D from the roof tank to the heater is by-passed through the deactivator around valve Z. While passing through coils G the water is heated up by exchange of heat from the hot water which is leaving the deactivator. The incoming water passes on through coils H, in which it is raised to 207° F., the temperature being regulated by the thermostat T and the steam valve S. At this temperature the water readily gives up its dissolved gases as it falls over the cascade plates K. The de-aerated, non-corrosive water leaves the machine via the exchanger section, in which it gives up a large part of its heat to the incoming cold water. The temperature of the water passing to the heater is approximately 120° F.

New Type of High-Pressure Boiler Water Feeder.

An interesting device to meet the demands of modern power plant installations, especially where a constant and accurate feed is required in safety water-tube boilers carrying water into steam drums, has been developed by Kieley & Mueller, Inc., New York. Its operation is shown in the accompanying illustration. It is notable in having no hydraulic-operating valve and piping in connection with a diaphragm valve or expansion tubes.

The feeder consists of a centerport balanced water valve, exposed to view of the operating engineer, deriving its action from an enclosed non-collapsible cast-iron float in the casing, which responds to slight variations of water and can be adjusted to open wide, allowing the full area of the feed pipe to be utilized with a drop of 1 in. of the water level in the boiler. The seats and discs are easily renewed by removing the bonnet of the valve only, the casing being tapped for gauge glass and try cocks. This makes the valve answer the purposes of a water column.



NOVEL TYPE OF WATER FEEDER TO HIGH-PRESSURE BOILERS

In the operation of the device it is recommended by the manufacturers that a steam pump governor be used that will maintain a constant charged pressure in the feed line above the point of the safety valve blow-off, thus making a complete automatic feeding system, suitable for various sizes of boilers, whether placed in batteries or single. The feeders are made in sizes from 50 H. P. up, also for the standard of 125 lbs. and the extra heavy 250 lbs. working pressure.

A Garbage Disposal Outfit for the Home.

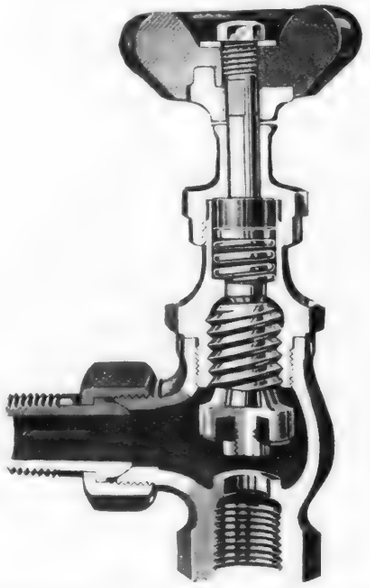
Most devices described in these columns purport to bear upon the problem of saving heat, or upon the allied problem of using heat for its most obvious function of combating cold. But there are other functions of heat which are no less real because they find less wide application. One of these is the combating of disease by destruction of bacteria and of conditions which favor bacterial growth.

The Incinerite recently placed on the market by E. C. Stearns & Co., Syracuse, N. Y., is a device for disposal of household garbage and waste by incineration. This apparatus operates on either natural, producer, or gasolene gas and is claimed by the maker to destroy either wet or dry animal or vegetable matter, without odor.

Two types are made, the built-in or wall type and the portable, which is designed for convenience of installation in existing dwellings. A flue connection is required for carrying away the waste gases. The gas connection will depend upon the kind of gas used. Obviously this device will provide a certain amount of heating capacity as a by-product of its main function and it will be interesting to note the effect which this will have upon the future of the device. Developed along the American plan, this may be expected to lead to the provision of an exterior shell resembling a pianola, allowing it to be used for warming purposes. Should the English tendency prevail, there will no doubt be developed an auxiliary grille attachment and an oven, which will necessitate changing the name of the device to Broil-incinerbake.

The Pierce Packless Valve.

In describing mechanical apparatus a good rule of procedure is the one which states that a single look at the "innards" is worth a cycle of text. The accompanying view of the Pierce packless valve illustrates the correctness of this principle, as well as the valve, which was described in the September number of HEATING AND VENTILATING MAGAZINE.



CONSTRUCTION OF PIERCE PACKLESS VALVE.

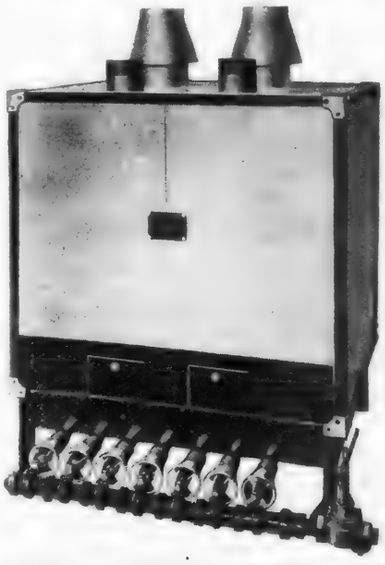
Water and Steam Boilers Using Gas Fuel.

The Hot Wave automatic gas fired boiler recently put out by the Gas Utilities Corporation, Pittsburgh, Pa., consists of a single section, copper tube boiler, op-

HOT WAVE AUTOMATIC GAS-FIRED BOILER.

erated by a set of specially-designed gas burners. This boiler is made for either water or steam heating service and operates on the water-tube principle. A double wall of asbestos covering with air space between the two layers, encloses the entire boiler and provides effective heat insulation.

By staggering the tubes there is obtained a tortuous path for the hot gas from the burners, ensuring high efficiency of



ASBESTOS COVERING OF HOT WAVE AUTOMATIC GAS-FIRED BOILER.

heat transfer assisted by the thermal conductivity of the copper tubes. Thermostatic control of a quick-acting gas valve regulates the gas supply to the boiler to meet service requirements. This valve is arranged to shut off the gas completely or turn it on full force if desired, and a pilot light, by-passed around it, serves to light the burners. This small pilot light, with a negligible gas consumption, is designed to burn from one end of the heating season to the other, so that the boiler will be constantly available for instant use.

A feature of the thermostatic control mechanism supplied with this boiler, is a clock attachment by which can be fixed the exact time in the morning at which a high temperature shall be attained, as well as the exact time at night when the apparatus shall operate to maintain a lower temperature suitable for night hours.

New Publications.

HEATING SYSTEMS, by F. W. Raynes, just published by Longmans, Green & Co., New York, is devoted to design of water and steam heating apparatus. This is the second edition of the work and represents considerable extension and some revision of the first edition to bring it up to date. Among the subjects treated in the twenty-four chapters are systems of piping for gravity water heating apparatus, accelerated water circulating heating systems, atmospheric systems of steam heating, exhaust steam heating, heat losses from buildings, sizing of pipes of steam heating systems, and temperature control of buildings. The book contains 324 pages with an appendix of 16 pages, octavo size, and sells for $7.50 net. This can be obtained from the publishers direct or through the book department of HEATING AND VENTILATING MAGAZINE.

Trade Literature.

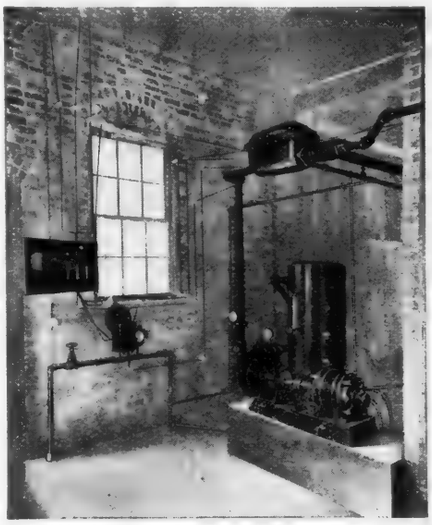
CORROSION—Its Cause and Cure—are the topics of a four minute essay just issued in printed form by the Elliott Company, Pittsburgh, Pa. Starting with a general discussion of the fact that rust and other forms of corrosion are due to the presence of air in the water, the pamphlet goes on to explain the various ways in which this action helps to create trouble in the domestic hot water system. The cure or remedy for these defects is explained to be exceedingly simple, practical, and complete. This remedy is the deaeration of the water which is accomplished by the Elliott deaerator, whose action the pamphlet describes in brief, without illustration. With cream-colored paper and a monogrammed cover and unburdened with views of the apparatus or tables of any kind, the booklet has a distinctly novel and artistic appearance. Size 4½ x 8 in. Pp. 12.

PULLS THE PROBLEM THROUGH THE ROOF, declares a leaflet of the Allen Air Turbine Ventilator Co., Detroit, Mich., referring to its well-known product, which is described as a true rotating air-driven suction turbine that pulls air up and discharges it through the roof, thus avoiding the necessity for expensive power-driven systems. The pamphlet points out that with this device there is no operating ex-

DESIGN OF ALLEN AIR TURBINE VENTILATOR

pense, that efficiency is guaranteed, and that it works in all weather. It permits no downdrafts. No statement is made regarding the turbine action as to whether it is of the impulse variety driven by outside air currents or of the reaction type driven by the exhaust air from the interior which it ventilates. It should be classed, however, as of the impulse type. The pamphlet gives guaranteed figures on air displacement and their relation to sizes and prices and it closes with a list of just a few of the many users. Size 3½ x 6½ in. Pp. 4.

KALAMAZOO VACUUM PUMP, manufactured by the Clark Engine & Boiler Co., Kalamazoo, Mich. is the subject of an interesting pamphlet issued by that concern. Opening with page illustrations of the apparatus as installed, the text then turns to a description of the operation of this apparatus. Some of the features are of special interest such as the fact that the pump is a patented, extra-high-efficiency design, absolutely hydraulicly balanced so that



TYPICAL INSTALLATION OF KALAMAZOO VACUUM PUMP.

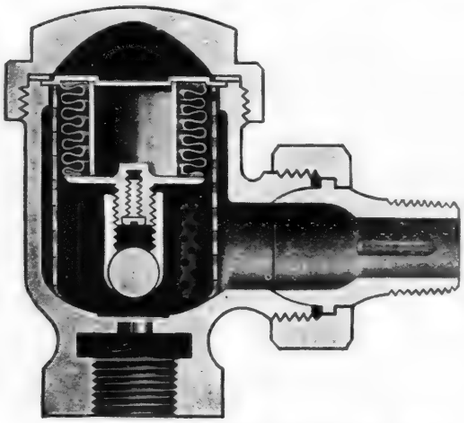
there is nothing to adjust or get out of order. The illustrations show one system of installation but many changes can be made to suit the boiler plant. Kalamazoo vacuum pumps are built for capacities from 3,000 to 200,000 ft. of direct radiation and larger units will be made when required. Two pages of illustrations on the boiler product of the same company complete the pamphlet. Size 6 x 9 in. Pp. 8.

ARMCO is the cryptic title which greets the eye from the top of a novel pamphlet at the bottom of which the message is decoded by the name of the American Rolling Mill Co., Middletown, O. This pamphlet takes the form of a file folder containing Bulletins No. 1, 3, 4, and 5 of that concern. These bulletins announce the purpose of the series and give brief details about open-hearth operation, and the rolling of ingots, bars, and sheets. For one who had never seen a rolling mill in operation, the art work which accompanies the descriptions would almost make it seem romantic. Stowed safely away in a filing cabinet the folder will not get the rough usage that an ordinary pamphlet might receive and will undoubtedly last much longer. Size 9 x 11½ in.

TITUSVILLE BOILERS AND MACHINERY, are presented in Catalog No. 81 recently published by the Titusville Iron Works Co., Titusville, Pa. Among the types of boilers described and illustrated are the Titusville Standard, Perfection portable, Perfection smokeless, Tico portable and smokeless, and the Acme brickset boilers, all of the horizontal tubular type. There are also shown several types of vertical

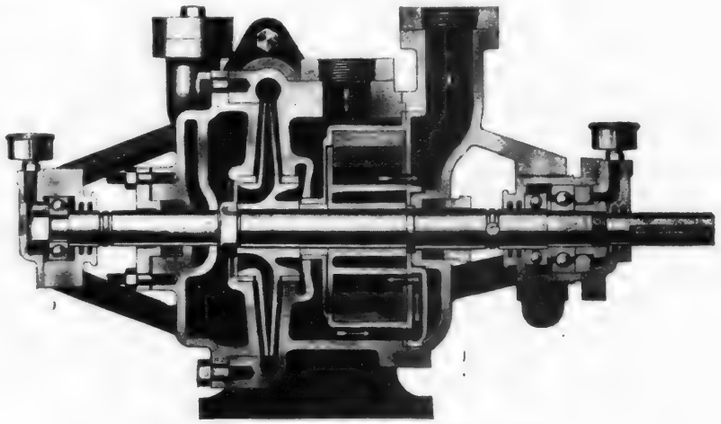
tubular boilers, water heaters, stacks, tanks, engines, pumps, gearing, and valves manufactured by the same concern. The illustrations are particularly good and the descriptive matter brief and to the point. Size 6 x 9 in. Pp. 92, including index.

RADIATOR TRAP SARCO, Type E, is described in a recent folder of the Sarco Company, Inc., New York. The spirally-corrugated expansion element in this trap is filled with a volatile fluid which expands under the heating action of steam and presses the ball down upon the valve seat. By filling the thermostatic element under vacuum the full movement of the valve is secured with a relatively small stress on the metal. Line contact between the ball and seat is designed to prevent trouble from collection of scale. The thermostatic element can be lifted out and replaced without affecting the adjustment, and protection is afforded by an internal screen having a mesh area ten times that of the valve seat. Roughing-in dimensions for the angle, straightway, right and left offset types are also given in this pamphlet. Size 6 x 9 in. Pp. 4.



DESIGN OF SARCO RADIATOR TRAP

JENNINGS HYTOR PUMPS are discussed in detail in two recent pamphlets of the Nash Engineering Co., South Norwalk, Conn., Bulletin No. 16 treats of the condensation pump, a centrifugal unit using the Hytor impeller and direct electric drive. The design of this pump is such that the horsepower required is closely proportional to the weight of water handled. The receiving tank contains an open cast-iron bucket float which is always kept full. This avoids all troubles from leakage. Air-line vacuum heating pumps are handled in Bulletin No. 17 and illustrations evidence the close relationship between this and the condensation pump. For this service and apparatus no receiver is required so that the complete unit is quite compact. The two bulletins are similar in style and typography and represent a high standard of trade publicity. Size 7½ x 10½ in. Pp. 4.



DESIGN OF JENNINGS HYTOR PUMP.

Novel Pump Circulars.

The next best thing to seeing the units themselves in operation is provided in the new circulars published by the Nash Engineering Co., South Norwalk, Conn., and devoted to the Jennings return line pump for use in connection with heating systems, and the Nash Hytor which operates as an air compressor and vacuum pump. In both circulars illustrations of the pumps have superimposed celluloid discs, representing the rotors, which can be made to revolve, giving a remarkably graphic idea of their operation. In the case of the Jennings pump, the disc visualizes very distinctly how the water, turning with the water in the elliptical casing, is constrained to follow the casing by centrifugal force, alternately receding from and being forced back into the rotor, twice in a revolution. It is also made clear how the water as it recedes from the rotor, draws in air through the inlet ports and, also, how it is that when the water is forced back into the rotor by the converging casing, the air is first compressed and then discharged through the outlet ports. In the case of the Nash Hytor, the same principle is shown in operation. A separate view indicates how the air passes through the casing. Each circular contains a cross-section view of the unit discussed, the bronze fittings of the Jennings pump being indicated by the proper color. Altogether the two circulars present an effective sales argument, and one decidedly up to the minute in its arrangement and appeal.

Is Our Atmosphere Getting Warmer?

Millions of tons of coal are burned all over the world every year. This coal develops a tremendous total heat which is eventually absorbed by the air. Consequently the air is warmed.

In addition we have millions of cords of wood, millions of barrels of oil and millions of cubic feet of natural gas being burned every year.

Does it not seem logical that all of this heat generated by combustion should make the atmosphere warmer? Does this account for the milder weather we are having during winter?

These questions came to me during the elegant fall of 1920 while I watched the thousands of automobiles rushing back and forth on the street and avenues of New York City. "Surely," I thought, "all of this burning gasoline must have an appreciable effect upon the temperature of the earth's atmosphere. Possibly this accounts for our excellent weather."

I decided to "Figure it out" and so wrote three letters to the foremost authorities in the United States in the three respective fields—coal; oil and gas; and wood.

YEARLY B. T. U. FROM COAL

The coal authority, Frank H. Kneeland of "Coal Age," answered my inquiry as follows:

"Prof. L. C. Breckenridge last week in a paper presented before the American Society of Mechanical Engineers stated that in 1913, the last year for which complete statistics are available, the production of coal in all countries amounted to 1,382,000,000 tons. Heat content could probably be roughly averaged at 12,500 to 12,000 B. T. U. per pound."

Using Mr. Kneeland's figures, I compute the total heat value to be

1,382,000,000 x 2,000 x 12,750 B .T. U., = 35,250,000,000,000,000 B. T. U. = total heat of coal absorbed by the earth's atmosphere every year.

YEARLY B. T. U. FROM OIL AND GAS

H. K. Landis, of "Gas Age," replied as follows:

"The figures you ask for can be obtained, but not for any recent date. For example, the latest figures regarding the world's production of petroleum are for 1918, when there was produced 514,729,351 barrels, in the world. In 1919, the United States produced 377,719,000 barrels. Since the production has been increasing this year, the approximate production at the present time can be readily estimated, and the world production obtained from it.

"In a recent address, Secretary Welch of the American Petroleum Institute, stated that the present rate of oil consumption in this country is 625,000,000 barrels per year.

"The 1915 edition of Mineral Resources gives the world's production of natural gas

as 650,789,779,000 cu. ft. This production has been increase considerably, and does not include all the producing fields we are certain. If we estimate a production of 700 billion, with a heat value of 1,000 B. T. U. per cu. ft., we get 720,000,000,000,000 B. T. U. from natural gas per year.

"Assuming a world production of 600,000,000 barrels of oil of 42 gallons each, or 25,200,000,000 gallons or 189,000,000,000 lb., and assuming 18,500 B. T. U. per pound we get a total of 3,500,000,000,000,000 making a total of 4,220,000,000,000,000 B. T. U.

"We would not care to be quoted upon the accuracy of these figures, but you can realize the difficulty of securing any authoritative report at the present time on the foreign production of oil or natural gas."

YEARLY B. T. U. FROM WOOD

Elmer C. Hole, editor of "American Lumberman," wrote as follows:

"The reply to this might be restricted to fuel only, or it might include all forest products from lumber down to tankbark. It is about as easy to answer one way as the other; for, outside of the United States, very few official statistics can be found; and totals should be regarded as little better than guesses. Yet statistics furnish a basis for some estimates.

"The people of the United States use 100,000,000 cords of fuel wood a year, according to Pierson's estimate published ten years ago. The cord is supposed to contain 128 cu. ft. but really it is not more than 90 cu. ft. As to the wood for fuel in the rest of the world, it is anybody's guess. Our guess is that, per capita, it is not more than one-fifth as much as in the United States. That would foot up, for fuel, 100,000,000 cords per year in this country and 280,000,000 cords in the rest of the world, or a grand total of 380,000,000 cords.

"If the estimate is to include lumber, pulpwood, poles, railroad ties and all other forest products made of wood, the estimate for the United States should be doubled, totaling 20,000,000 cords. It seems reasonable that the estimate for the rest of the world should be doubled also, to include all forest products, or a total of 560,000,000 cords. Adding for the grand total of all forest products for the world, the result is 760,000,000 cords.

"That may be within fifty per cent. of the actual amount, but who can say whether it is above or below? It is well known that the people of this country use more wood per capita than those of most other countries. The above total estimate is based on the assumption that, per capita, we use four times as much as the rest of the world."

Editor Hole did not state the heat value of this wood, so I will attempt to figure it. Paper No. 98 of a series of technical notes issued by the Forest Products Laboratory, U. S. Forest Service, Madison, Wis., says: "A ton of coal may be taken as the equivalent in heating value of one cord of heavy wood, 1½ cords of medium-weight wood, or 2 cords of light wood."

Assuming that the average is "medium-weight" we have an equivalent of 760,000,000 ÷ 506,000,000 tons of coal,
or 506,000,000 x 2,000 x 12,750 B. T. U. = 12,900,000,000,000,000 B. T. U.

WORLD'S TOTAL HEAT GENERATION PER YEAR IN B. T. U.

Adding our three totals coal; oil and gas; and wood we now get the "world's total heat" generated per year as follows:

	B. T. U.
Coal	35,250,000,000,000,000
Oil and Gas.....	4,220,000,000,000,000
Wood	12,900,000,000,000,000
World's Total.....	52,370,000,000,000,000

HOW MUCH AIR IS THERE?

This is a comparatively easy question to answer. It is easier to answer than, "What is the total heat generated per year?" The quantity of air can be computed with far greater accuracy because it is known that the pressure of air on every square inch of the earth's surface is very close to 14.7 lbs. per sq. in. It is thus merely a matter of determining the area of the surface of the earth in square inches and multiplying by 14.7. The product will be the "total pounds of air."

The area of the earth's surface in square inches is equal to $3.1416\ d^2$; where d = the diameter in inches.

The earth's diameter is usually given as 8000 miles = 42,200,000 ft. = 507,000,000 in.

Area = 3.1416 x 507,000,000 x 507,000,000 = 807,000,000,000,000,000 sq. in.

Multiplying this by 14.7 we get 11,850,000,000,000,000,000 lb. of air.

EFFECT ON ATMOSPHERE

Now that we have the total heat and the total weight of air and knowing that 0.2375 B. T. U. will raise the temperature of one pound of air one degree Fahrenheit we get this:
52,370,000,000,000,000 B. T. U. ÷ 0.2375 = 220,000,000,000,000,000 = the number of pounds of air whose temperature would be increased 1 degree F. by the total heat.

However, we have found that there is much more air in the world than 220,000,000,000,000,000 lbs. There are 11,850,000,000,000,000,000 lbs. The latter figure is 54 times the other. In other words, all of the heat produced on earth per year will increase the temperature of our atmosphere only 1/54th of one degree Fahrenheit. That is, it would take 54 years for all of the heat, applied at the same rate every year, to raise the temperature of our atmosphere one degree.

In view of this extremely small temperature increase per year; in view of the fact that vegetation absorbs carbon dioxide, one of the products of combustion; and in view of other things that we do not fully understand; I conclude that the temperature of our atmosphere remains unaffected by the activities of human beings.

W. F. SCHAPHORST.

Quantity Surveys and Payment for Estimating.

Supplementing material on the same subject presented in the July number of HEATING AND VENTILATING MAGAZINNE, which had only the weight of tentative suggestion at that time, the following recommended procedure for archetects, engineers, builders (that is, contractors and sub-contractors), and owners is now given as finally approved and adopted by the Associated General Contractors of America, the American Engineering Council of the Federated American Engineering Societies, and the American Institute of Architects.

RECOMMENDATIONS

1. Quantity surveying—Architects, engineers and contractors should jointly use their efforts to have established facilities for making quantity surveys.

2. Payment for quantity of surveying—The owner should pay for the quantity survey from ¼% to 1% of the cost of the project for commercial and public work, and not more than twice as much for residence work, whether the project is constructed or not.

3. The cost of the project be defined as the accepted bid, or in cases where no bid is accepted, the bid of the lowest responsible bidder as determined by the architect or engineer. However, in cases where alternate bids are required, the additional payments for the quantity surveys shall be based upon the additional quantities surveyed, as approved by the architect or engineer.

4. Altered plans which involve a change in quantities after the quantity survey has been made justify an addition to the original fee for quantity surveying.

5. Basis of contract—Owners should have the option of—

(a) Making the quantity survey a part of the contract, or

(b) Permitting the successful bidder, at his own expense, an opportunity to verify the accuracy and completeness of the quantity survey before the contract is signed. If he proves errors to exist in the quantity survey, the bidder shall be permitted to adjust his bid accordingly.

Compactly-Designed Condensation Pump and Receiver.

The new unit brought out by the Chicago Pump Co., Chicago, Ill., for heating plant and similar service has been designed with the special object of quantity production and correspondingly low price. It has been limited to four standard sizes to handle from 2000 to 8000 sq. ft. direct radiation against pressures up to 10 lbs. Parts have been so standardized as to be interchangeable. Of particular interest is the plan by which a user of the Chicago pump who wishes to replace the shaft and bearing because of wear and to have the same repacked can secure a new pump at once and return the old pump in part payment considerably reducing the total expense for the replacement and avoiding all delay.

Death of J. A. Bendure.

We are now able to publish a more adequate notice of the death of J. A. Bendure whose recent death was a shock to his many friends in the heating trade, especially the central station heating industry. Mr. Bendure was in many ways a pioneer consulting heating and electrical engineer and had traveled throughout the East, Middle West and Canada in this capacity. To his intimate friends he was known as "J. A." and a business visit from him was a pleasure because of his rare optimism. He was a self-made man and was considered the soul of generosity.

THE LATE J. A. BENDURE.

Mr. Bendure was 63 years old. He was born on a farm near Decatur, Ill., and his young manhood was spent in the study of power plants and machinery. In 1881 he became engineer for the electric light plant in Ottawa, Kan., one of the first of its kind in that State. He next became manager of the Pittsburg Railway, Light and Water Company, in Pittsburg, Kan. Here he built one of the first electric street railways in the West.

He became manager of the Atchison Railway, Light & Power Company of Atchison, Kan., in 1892, and installed its first electric street railway system. In 1903 he went to Lima, O., as manager of the Lima Railway, Light & Power Company. While in Lima he installed an extensive underground central station heating system.

Mr. Bendure was called to Lockport, N. Y., in 1906, to become manager of the Lockport Heat and Light Company, which was owned by the American District Steam Company. After building up this property he opened an office in Buffalo, N. Y., as a consulting electrical engineer and contractor for central station heating and lighting plants. After two years of this work the American District Steam Company again secured his services in the capacity of sales engineer which position he held until a year ago. At the time of his death he was with the W. H. Ballard Company, of Boston, Mass., assisting in the managing and operating of 45 large business blocks and heating plant in Boston owned by that firm.

His death was due to heart failure and occurred the day after his 63rd birthday. He is survived by his wife and one son.

Mr. Bendure was a member of the American Society of Heating and Ventilating Engineers and also belonged to the Masonic order, Knights of Pythias, Elks and Modern Woodmen.

Typical Fuel-Oil Installation in San Francisco Office Building.

In the new Balfour Building, in San Francisco, which is the latest addition to the modern office buildings of the Golden Gate City, there are two steam boilers operated by Johnson low-pressure crude-oil burning equipment. The oil pump and blower set is a 7½ H. P. Crocker-Wheeler 1425 R. P. M. direct-current motor, with sliding base, driving a Victor Boston type blower by means of an endless leather belt and driving a No. 3 rotary fuel-oil pump by means of a silent chain drive.

The fire boxes of the boiler are lined with fire-brick, the furnace door being made up of a 4½-in. thickness of Silocel brick over which there is a 2½-in. thickness of fire-brick.

The oil heater is of cast-iron, with an iron pipe coil. Both the steam pipes and the oil heater are covered with 85% magnesia covering 1 in. thick.

A riveted steel tank 6 ft. 6 in. in diameter, with bumped ends, is provided for storing the oil. The shell of the tank is 13 ft. long, exclusive of the bumped ends. The suction pipe is 2½ in. in diameter and is installed at a point 2 in. above the bottom of the tank.

ARRANGEMENT OF BURNER.

The burner is of such design that it may be throttled to the minimum fire necessary to maintain steam on the boiler with all radiators, coils and heaters shut off, without the fire being extinguished. Another feature of the burner is its arrangement to automatically regulate the steam pressure at any desired point within the capacity of the boiler. The motor driving the burner is wound for 230 volts, direct current, and is direct connected.

There has also been installed a device which will automatically and completely shut off the oil to the burner if the steam pressure should reach 10 lbs. This device is operated by means of a separate siphon damper regulator actuating a quick-opening straight way valve in the oil to the burner line. It is so designed that when once closed it will remain closed until reset by hand. There is a spring attached to the operating lever which will close it when released. This spring is nominally held open by a cotton cord which is stretched across the floor in front of the burner and fastened at the end away from the spring. The apparatus is so arranged that the burning of this cord will release the spring and close the valve.

The building is heated by a vacuum steam system, supplying small Colonial type wall radiators. This supplemented by a ventilating system, including air washer equipment, which extends to the first and mezzanine floors.

King Plumbing & Heating Co., Seattle, Wash., heating and plumbing the $1,500,000 Roosevelt High School, for $181,156. Following are the bids submitted for this work:

	Heating.	Plumbing.
King Plumbing & Heating Co.	$133,156	$48,000
Rautman Plumbing & Heating Co.	160,485	53,987
P. J. Lavan	148,908	49,897
J. A. Scherer	138,958	.....
McMahon Plumbing & Heating Co.	148,990	48,449
Norton & Spangler	156,525	54,926
Ashwell & Twist	148,798	57,136
Dupar-Blythe Co.	151,579	45,156
Wenzler & Ward	149,568	48,302
University Plumbing & Heating Co.	144,456	50,163
Hellenthal Plumbing & Heating Co.	146,988	49,640
P. J. Glennon	.....	46,498

Riggs, Distler & Stringer, Baltimore, Md., heating and ventilating fifteen school buildings throughout the city.

William H. Conklin, Toledo, heating and ventilating the $500,000 Webster School at Manhattan Boulevard and Elm Street, Toledo.

Barr & Creelman, Rochester, N. Y., heating and ventilating new Hillside Avenue School, for $36,381. The Spencer Turbine Company was awarded the vacuum cleaner installation at its bid of $2,897. Barr & Creelman was also awarded the contract for heating and ventilating No. 33 School, on Grand Avenue, Rochester, at its bid of $20,420.

Kata-Thermometers

FOR SALE BY

SIEBE, GORMAN & CO., Ltd.

H. N. Elmer

General Agent for North America

1641 Monadnock Building

CHICAGO, ILL.

In many homes, particularly town houses or apartments, the space for the heating boiler is very small and frequently adjoins the entrance hall. The IDEAL Type "A" Heat Machine is admirably designed for plans of this character

Economy of Fuel and Space

"It burned 40% LESS COAL this year."—This statement from a grateful owner exceeds the tabulated results from hundreds of installations of IDEAL Type "A" Heat Machines—which average **A FUEL SAVING OF ONE-THIRD.** Besides this fuel economy, this reduced amount of coal requires one-third less storage space, and caretaking.

The **Large Fuel Chamber** holds enough coal to run without attention from 8 to 24 hours, depending upon weather demands.

The **Revertible Flues** and scientifically proportioned surfaces absorb and utilize the heat, preventing its waste up the chimney.

The **Automatic Regulation** prevents waste of heat by controlling the fire to supply the exact volume of heat needed—avoiding *under*-heating and *over*-heating..

The **Ideal Insulated Jacket,** dust-free and gas-tight, permits converting the basement into livable, recreational quarters.

We offer testimonial letters from many prominent users. Specify and use IDEAL Type "A" HEAT MACHINES for NEW or OLD residences.

Write for catalog containing test charts of FUEL ECONOMY and efficiency.

IDEAL Type "A" Heat Machine

IDEAL products are nationally priced and sold by all heating contractors. No exclusive Agents.

AMERICAN RADIATOR COMPANY

Sales Branches in All Large cities

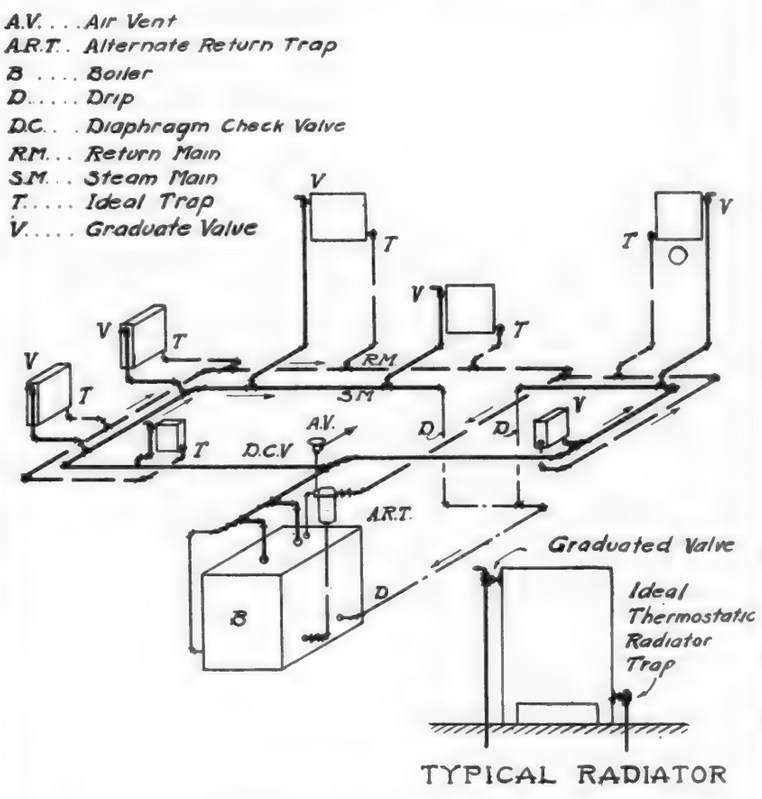
Makers of the world-famous IDEAL Boilers *and* AMERICAN Radiators

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. CITY

VAPOR HEATING.

The Ideal System.

A typical piping diagram of the Ideal System is shown in Fig. 1. Its outstanding feature is the use of the Ideal alternate return trap, shown in Fig. 2, which serves to drain the system of condensation, discharging the same directly into the boiler at any pressure up to 20 lbs. per square inch. This trap is designed to prevent the burning and cracking of boilers due to faulty circulation. It also serves to overcome spitting of water from air eliminators, receivers, or venting valves. The Ideal alternate return trap can be



IDEAL SYSTEM

installed as low as 8 in. above the water line in case the boiler room ceiling is low, but a greater height is recommended if possible.

When the system is operating under a few ounces of pressure, the alternate return trap acts simply as an open receiver and air vent. But, if for any reason the boiler pressure rises, the accumulating condensation in the trap lifts a float which automatically closes the air valve and opens the steam valve, admitting boiler pressure to the top of the trap and forcing the water in the trap down into the boiler. After this discharge (or rather along with it) the float drops, closing the steam valve and opening the air valve. A few repetitions of this process will serve to reduce the boiler pressure to a few ounces, allowing the condensation to return again by gravity.

(*Concluded on Data Sheet No.* 132-AA)

VAPOR HEATING—The Ideal System | No. 132-Z

Copies of this Data Sheet, printed separately, 5 cents each.

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. CITY

VAPOR HEATING.

The Ideal System.

(Concluded from Data Sheet No. 132-Z)

Air leaving the alternate return trap, passes through the Ideal diaphragm check valve, shown in Fig. 4, which offers no resistance to its outward flow but prevents any return of air to the system.

What the Ideal alternate return trap is to the system as a whole, the Ideal thermostatic radiator trap is to the individual radiator. This trap as shown in section in Fig. 3, is seen to be of the vertical type which is self-cleaning in operation. Attached to the return

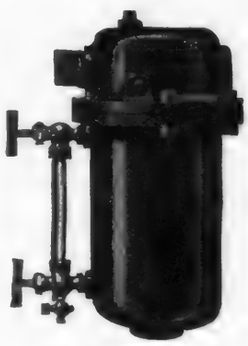


FIG. 2—IDEAL ALTERNATE RETURN TRAP.

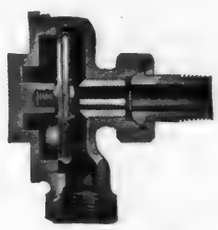


FIG. 3—IDEAL THERMOSTATIC RADIATOR TRAP

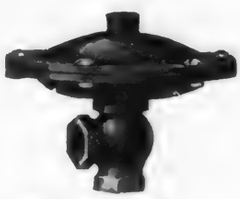


FIG. 4—IDEAL DIAPHRAGM CHECK

FIG. 5—IDEAL RADIATOR VALVE.

end of the radiator this trap serves to drain it of condensation and to maintain within it under proper operating conditions, a satisfactory vacuum.

The Ideal radiator valve shown in Fig. 5, is placed at the supply end of the individual radiator and by reason of its graduated dial offers a means for regulating the rate of heat supply. This valve is packless and quick-acting and is so designed that its disc is readily renewable.

Water type radiation is recommended for use in connection with the Ideal System by its manufacturer, the Ideal Heating Equipment Company, Cleveland, O.

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THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. CITY

VAPOR HEATING

The Imico System

A minimum of special appliances marks the Imico System of vapor vacuum heating, typical piping diagram of which is shown in Fig. 1. There is no air valve at the radiators in this system and no trap on the return end of the individual radiator. Vacuum is maintained in this system by the Dewey tri-duty air and vacuum trap, which is a combination of the Dewey quick vent air valve and the Dewey vacuum valve.

The principle on which the Dewey tri-duty air and vacuum trap eliminates air is very simple. There is a connection from the supply pipe, or pressure side of the boiler, to the diaphragm and under normal conditions this diaphragm is closed. When the fire is started and the air in the boiler is expanded, the diaphragm is inflated and opens the vacuum valve, making a direct opening through the trap to the atmosphere. This valve remains open as long as there is a fraction of an ounce pressure on the boiler, unless the vapor having passed through the entire system is forced into the float chamber, which instantly closes against vapor. If water should be forced up the return pipe, the float rises in the chamber and closes it, keeping it cloed until water recedes, when it opens again and commences venting air. With this trap installed there is no chance for back-pressure in the radiators, since it will close against either steam or water and will prevent the return of air to the system.

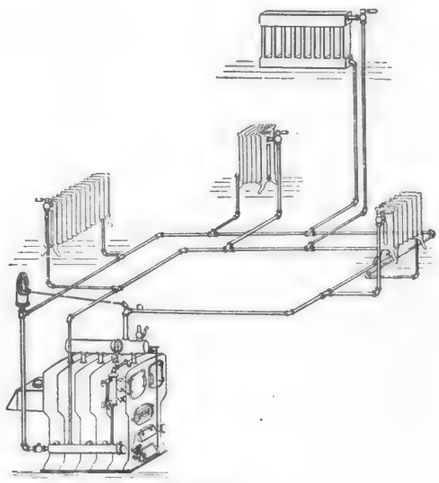

FIG. 1

Radiators for the Imico System of vapor vacuum heating may be the same size as for steam, but an increase of 10% over the radiation as computed for the ordinary steam job, is recommended by the manufacturers, the Illinois Malleable Iron Company, Chicago, Ill., to promote economy in coal consumption. Either steam or water radiation may be used, tapped at the top, and the supply valves at the radiators should be of the graduated type.

The boiler should be provided with a regular safety valve and controlled by a well balanced damper regulator.

(*Concluded on Data Sheet No.* 132-CC)

VAPOR HEATING—The Imico System No. 132-BB

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THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY. N. Y. CITY

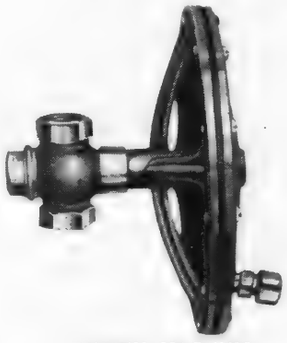
VAPOR HEATING.

The Imico System.

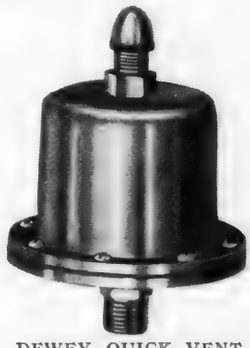
(Concluded from Data Sheet No. 132-BB)

Supply Main Sizes

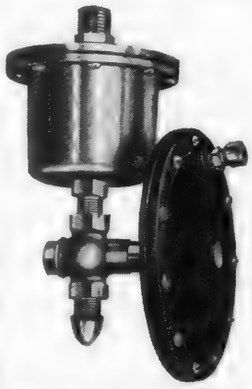
1½-inch	will	supply	200	feet	to	400	feet	Radiation
2	"	"	"	400	"	"	700	"	"
2½	"	"	"	700	"	"	1100	"	"
3	"	"	"	1100	"	"	1500	"	"
3½	"	"	"	1500	"	"	2000	"	"
4	"	"	"	2100	"	"	3000	"	"
5	"	"	"	3000	"	"	5000	"	"



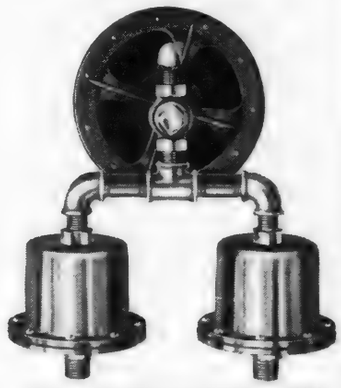
DEWEY VACUUM VALVE



DEWEY QUICK VENT AIR VALVE



DEWEY TRI-DUTY AIR AND VACUUM TRAP.



DEWEY DUPLEX TRI-DUTY AIR AND VACUUM TRAP

Return Pipe Sizes

1	-inch	at	boiler	will	return	200	feet	to	700	feet	Radiation
1¼	"	"	"	"	"	700	"	"	1110	"	"
1½	"	"	"	"	"	1100	"	"	2100	"	"
2	"	"	"	"	"	2100	"	"	5000	"	"

Tapping Size for Radiation

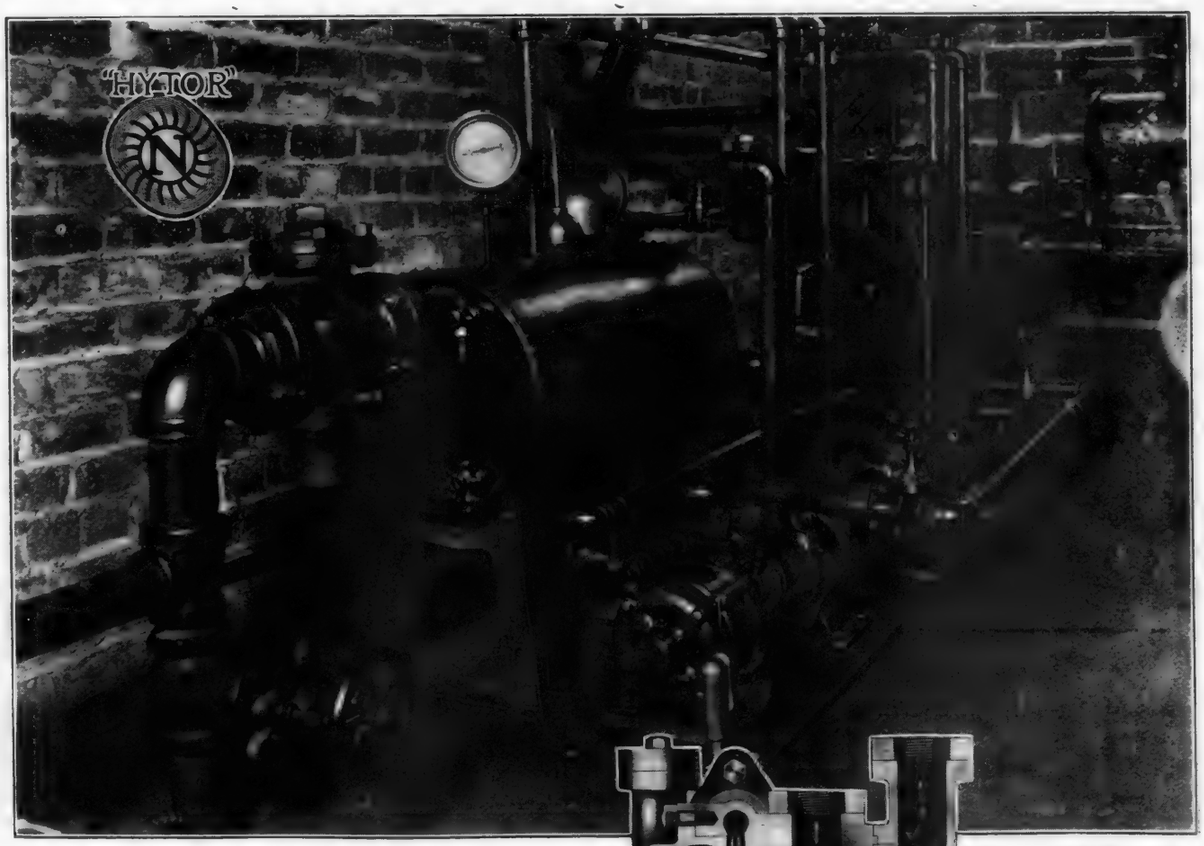
Size of pipe supply:

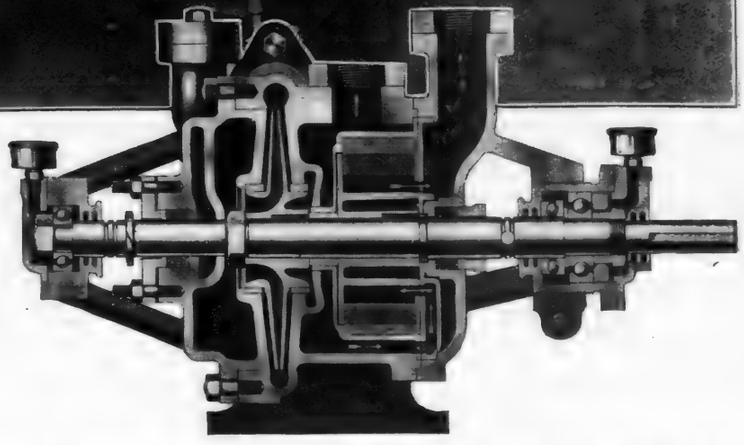
Radiation	90	square	feet	or	less		¾-inch	pipe	and	¾	-inch	graduated	valve.
"	90	feet	to	150	feet		1	"	"	"	¾	"	"	"
"	150	"	"	300	square	feet	1¼	"	"	"	1	"	"	"

VAPOR HEATING—The Imico System (Concluded)

Copies of this Data Sheet, printed separately, 5 cents each.

EFFICIENT HEATING *demands the* JENNINGS PUMP





Duplex "A" Unit, Continuous Operation

BOEING AEROPLANE CO.,
SEATTLE, WASH.

Capacity each pump 8,000 square feet direct radiation; air capacity 6 cubic feet per minute in addition to a water capacity of 11 gallons per minute.

The motors are only one horse power.

THE Jennings Pump consists of two independent turbine units, an air pump and a water pump. As each material is handled separately, the boiler pressure is against the water only. The air and vapor, approximately four-fifths of the volume handled, are delivered to atmosphere without back pressure. The saving in horsepower is over fifty per cent. In other words, the current to operate is cut in half.

Because of its compact design, this equipment can be installed in less than one-third the space necessary with other apparatus. All interior parts are bronze, supported on annular ball bearings mounted outside of casing. Moving parts revolve without contact.

A quiet, reliable operation with minimum expense for repairs and without annoyance because of shut-downs, is assured if the Jennings Pump is installed on your Vacuum Heating System.

There are many other reasons why the Jennings Pump is being installed in practically all of the important buildings. Bulletin No. 15 gives them in detail. Write for it.

THE NASH ENGINEERING COMPANY

SOUTH NORWALK, CONN., U. S. A.

TRADE AND MISCELLANEOUS NOTES

Miscellaneous Notes.

American Institute of Chemical Engineers will hold its fourteenth annual meeting in Baltimore, December 6-9, 1921.

American Public Health Association, which will hold its fiftieth annual meeting in New York, November 14-18, at the Hotel Astor, has arranged to have Sunday, November 13, observed as Public Health Sunday in the churches of New York City. Most, if not all, of the sessions of the meeting will be held at the Hotel Astor.

Jefferson City, Mo.—According to a survey just completed by E. A. Logan and Jewell Mayes, of the Missouri Co-Operative Crop Reporting Service, the old-fashioned heating stove is passing away from farm homes in Missouri, as well as from city homes, and is being replaced by steam and water heating systems and warm-air furnaces. There are 15,748 heating systems on farms in the State, according to the report, an average of six per hundred farms. Of the total number 10,771 are warm-air furnace systems, 3,020 water and 1957 steam.

Chicago, Ill.—The Dailey building investigating commission has renewed its activities, Senator John Dailey, chairman, promising "a thorough investigation of recent price increases in steam heating apparatus, lumber and other building materials."

Tenth Annual Congress of the National Safety Council was held in Boston, at the Massachusetts State House, September 26-30. One of the features of the congress was a demonstration of how a billion dollars a year can be saved to the industries of this country by the prevention of the 20,000 deaths caused annually by industrial accidents, and the thousands upon thousands of injuries sustained by workers in industry. The problem of maintaining effective safety work during the present business depression and accomplishing this enormous saving was discussed at length. In connection with the meetings on public safety, one was given over to the solution of the automobile accident problem. Coincidentally with the safety congress a "no accident campaign" was staged throughout the New England States, in which industrial organizations all over this territory were asked to conduct special drives on their properties to teach their employees more about safety.

Building Operations in August, 1921, according to figures published by the F. W. Dodge Company, were 4% greater than in July and 9% greater than in August, 1920. Contracts awarded during August, 1921, in the 27 northeastern States of the country amounted to $220,972,000. Residential construction continues in the lead over all other classes of buildings. It accounted for 36% of the total in August. Public works and utilities amounted to 20% of the total; business buildings to 16%, educational buildings to 13%, and industrial buildings to 5%.

In New England the activities were practically the same as in July, the figures coming to $20,560,000. In New York State and northern New Jersey, there was an increase of 11% over July. In the middle Atlantic States, the increase was 44%. Decreases were reported from the Pittsburgh district of 24% from July, and from the Northwest of 25% from July. In the central West, there was a slight increase of 3%.

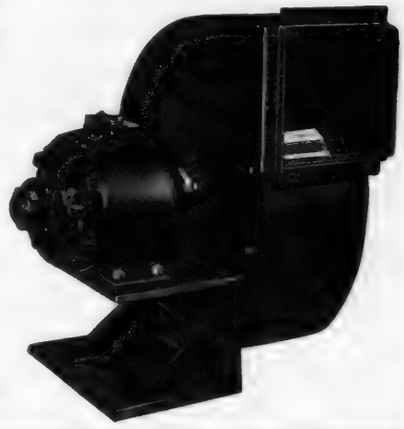
American Gas Association will hold its third annual convention and exhibition in Chicago, November 7-12, in the Congress and Auditorium Hotels. It is announced that more than 100 manufacturers will exhibit their latest gas-burning

(Patented)

Autovent Fan and Blower products are becoming so widely and extensively known among the trade and also the public, that you cannot afford to overlook the wonderful sales possibilities of the Autovent line.

The expansion and growth of your business depends almost entirely on the class of equipment you handle and the kind of service you render your customers.

If you want to be perfectly certain of obtaining the most efficient and reliable fan equipment manufactured and receive service that is unsurpassed, you cannot go wrong by placing your orders with a manufacturer whose motto is QUALITY, SERVICE and CO-OPERATION.



Autovent Fan & Blower Co.

Formerly

Batterman-Truitt Co.

General Offices and Works **730-738 W. Monroe St., Chicago**

appliances for both heating and cooking purposes. During the past year a number of notable advances have been made in the use of gas for house-heating work which will make the convention one of unusual interest to heating men.

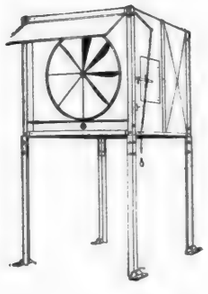
Cleveland, O.—Opportunities for better acquaintance on the part of the heating engineers and heating contractors of Cleveland were afforded at the joint outing of the Ohio Chapter of the heating engineers' society and the Heating and Piping Contractors' Association of Cleveland, at Geauga Lake, August 20. J. Mason, of the Utica Heater Company, and R. Morgan, had charge of the arrangements which included numerous sporting events.

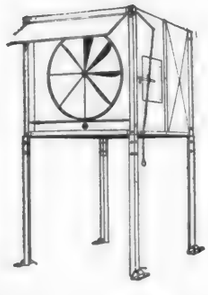
National Association of Sheet Metal Contractors has moved its headquarters to the Washington Building, 608 Chestnut St., Philadelphia, Pa.

Bureau of Mines, Washington, D. C., has recently completed a motion picture film, showing the asbestos mines of the Johns-Manville, Inc., and the various factories and processes in the mining, refining and manufacture of asbestos into its numerous products, such as insulations, packings, roofings, brake linings and other products. The picture is in four reels and runs a little less than an hour. It is announced that the film is available for presentation by clubs, engineering societies, Y. M. C. A.'s, etc. Application should be made to the advertising manager of Johns-Manville, Inc., Madison Avenue and 41st Street, New York.

Washington, D. C.—Hearings on a bill providing for the compulsory adoption after ten years of the metric system of weights and measures are to be conducted by a sub-committee of the Senate Committee on Manufactures, which is composed of Senator McNary, Oregon, chairman; and Senators Weller of Maryland and Jones of New Mexico. The bill provides, among other things, that after a waiting period of ten years no person shall sell any goods, wares or merchandise (except for export) nor charge or collect for carriage or transportation in or according to any other system than the metric system of weights and measures. In a statement issued by the American Institute of Weights and Measures, which is opposing the bill, it is pointed out that under this proposed law the American people would be compelled to discontinue the use of the mile, yard, foot, inch, pound,

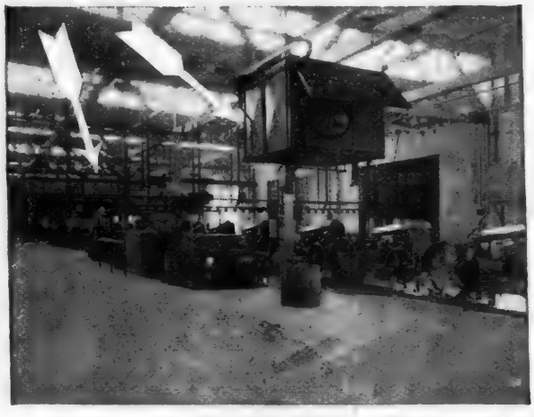
A PROFITABLE 24 HOUR HEATING CHART





ILGAIR UNIT HEATERS

Here is the conclusive answer to the Most Important Problem of Industrial America. A method of heating where the cost is measured by the hourly working schedule.



Ilgair Unit Heaters distribute heat at the floor where it belongs at a cost that represents considerable saving

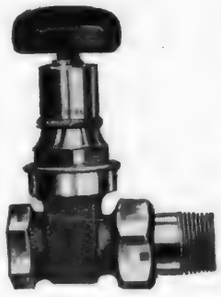
HEAT EFFECTIVELY IN WINTER AND COOL PLEASINGLY IN SUMMER

Send for Circular

ILG ELECTRIC VENTILATING CO., 2858 N. Crawford Ave., Chicago, Ill.

BRANCHES IN ALL LARGE CITIES.

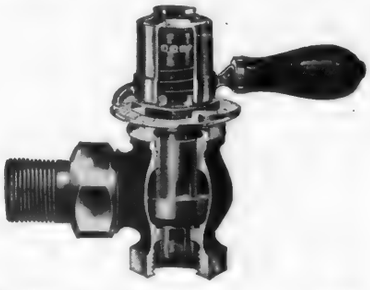
Dole



WE elected years ago to be the builders of the best radiator valves on the market. We have succeeded in our ambition. If any man desires to study the radiator valve field—he will become convinced of the fact that Dole Radiator Valves dominate their market.

A VALVE FOR EVERY SYSTEM

Write for catalogue and discounts



DOLE VALVE CO., Chicago, Ill.
1933 Carroll St.

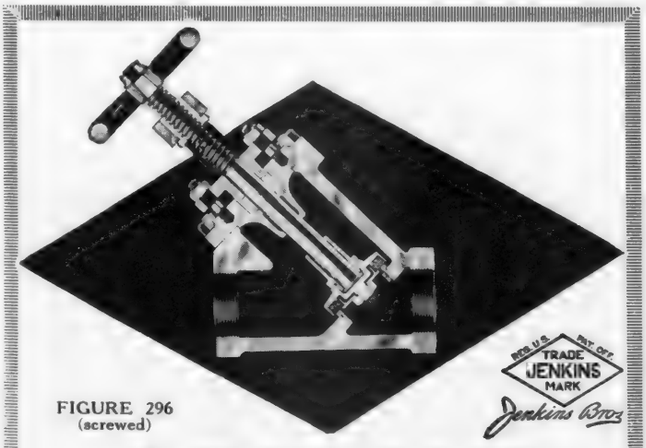


FIGURE 296
(screwed)

REG. U.S. PAT. OFF. TRADE JENKINS MARK
Jenkins Bros

Buy "signed" valves—with the Jenkins Diamond Mark and signature on the body.

Fig. 297--flanged

Jenkins Iron Body Y or Blow-off Valve, standard pattern for 150 pounds working steam pressure, or 250 pounds working water pressure. Fitted with Jenkins Renewable Disc. Has full, straight opening almost in line with the pipe. Used for Boiler Blow-off service, and for handling thick fluids.

AT ALL SUPPLY HOUSES
JENKINS BROS.
New York Boston Philadelphia
Chicago Montreal London Havana
Factories: Bridgeport, Conn.: Elizabeth, N. J.: Montreal, Canada

Jenkins Valves
SINCE 1864
2317-J

Just a ball —that's all

A ball can't get out of adjustment

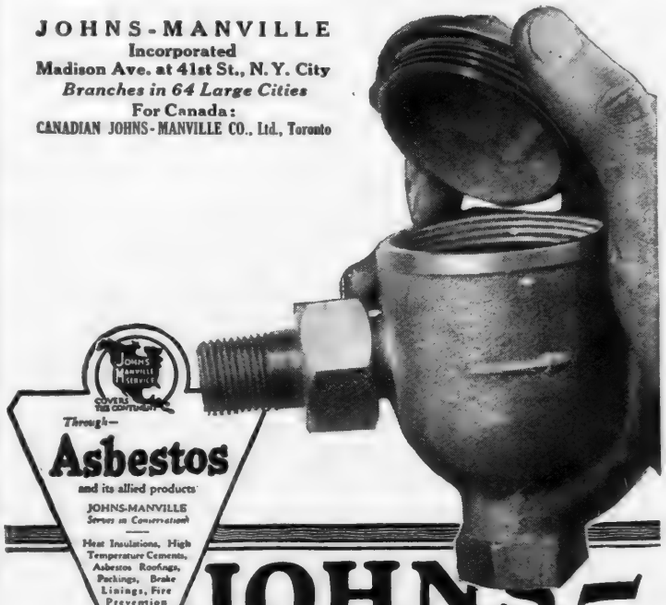
IN the Johns-Manville Radiator Trap the whole "works" is simply a floating metal ball.

When water enters the trap the ball rolls up and uncovers the outlet, allowing water and air to escape, but preventing the loss of steam.

Because of its simplicity, the Johns-Manville Radiator Trap eliminates the expensive tinkering and re-adjustment so often necessary where complicated mechanisms are used. There's obviously more profit in using a trap that you don't have to go back and adjust.

Write the nearest Johns-Manville branch today for complete details about this simple, profitable trap.

JOHNS-MANVILLE
Incorporated
Madison Ave. at 41st St., N. Y. City
Branches in 64 Large Cities
For Canada:
CANADIAN JOHNS-MANVILLE CO., Ltd., Toronto



Through—
Asbestos
and its allied products
JOHNS-MANVILLE
Serves as Conservation
Heat Insulations, High Temperature Cements, Asbestos Roofings, Packings, Brake Linings, Fire Prevention Products

JOHNS-MANVILLE
Radiator Trap

ton and gallon and use the kilometer, hectometer, dekameter, centimeter, millimeter, kilogram, hectogram, dekagram, gram, liter, dekaliter, hectoliter, etc. The institute has prepared an estimate of the cost of making the change, based on figures furnished by a number of manufacturers. It is shown that the aggregate cost to 31 concerns would be $21,464,688, or an average cost for each concern of $715,489.60. The number of workers employed by these 31 concerns total 94,392, making the average cost per worker, $227.40.

Manufacturers' Notes.

Howard Iron Works and Alberger Heater Co., Buffalo, N. Y. manufacturers of expansion joints and water heaters, now have offices in New York City at 1777 Woolworth Building. S. D. Harding and G. S. Whiffen are in charge.

Batterman-Truitt Co., Chicago, Ill., announces that its firm name has been changed to the Autovent Fan & Blower Co. The company's address remains the same, 730-738 West Monroe St., Chicago. There has been no change in the personnel or management of the company. This change in corporate name only was adopted on the ground that a corporate name which is indicative of the products, as manufactured by the company, will be more beneficial to all concerned. The company's product includes Autovent fans, Autovent louvres and Uniblade blowers.

Metals Coating Co. of America, manufacturer and distributor of the Schoop metal spraying process, by means of which metallic coatings of any kind may be sprayed on to any surface, is now in full operation in its new plant, 495-497 North Third Street, Philadelphia, having removed from its former Boston and Woonsocket, R. I. locations.

American Radiator Co., Chicago, under date of September 3, announced a moderate advance in prices of American radiators and Ideal boilers, effective on that date. In its announcement the company states:

"At the beginning of the year, the American Radiator Company realized the need to reduce costs and selling prices in order to contribute its full share towards the restoration of general business activity. Its policies were based upon that principle, not only that it might render a distinct service in the public interest, but through such service contribute to its own and the best interest of its customers.

"Selling prices have been reduced from time to time, not in response to realized or demonstrated reductions in cost, but in anticipation thereof. These reductions have been substantial and have undoubtedly contributed in no small way to the encouragement of renewed building activity. The selling prices heretofore maintained were relatively the lowest that have prevailed in a score of years; in fact, so low that the recent advance in the price of pig iron has made it absolutely necessary to make a moderate advance in prices.

"Radiators and boilers have been reduced in price by a larger percentage than any other item or items in the entire list of building materials. The moderate advance in prices effective this day is made in response to insistent need therefor."

U. T. Hungerford Brass & Copper Co., Philadelphia, Pa., has purchased the merchandise stock of the A. P. Swoyer & Co., at 17 North 7th St., Philadelphia. The company has also leased the premises formerly occupied by the Swoyer concern and will carry at that address a full line of brass, copper, tobin bronze, nickel silver and Monel metal products, in sheets, rods, tubes, wire, nails, tacks, etc.

Central Station Heating Notes.

Charleston, Ill.—The announcement of the Illinois Public Service Company of its intention to discontinue the central station steam service permanently has caused Mayor Dunn of Charleston to appoint a committee of four, including Aldermen Abbott, Craig, Decker and Kane, with the mayor and city attorney, to see what can be done to save the service. In the meantime the local heating contractors are in for a rush business this Fall, if the decision of the public service company becomes effective.

ATMOSPHERIC CONTROL
is commonly known as air conditioning by which inner spaces can be automatically maintained at the temperature and relative humidity best adapted to the requirements.
Humidifying—Dehumidifying
Cooling—Drying—Cleansing
AUTOMATIC HUMIDITY CONTROL
ATMOSPHERIC CONDITIONING CORPORATION.
LAFAYETTE BUILDING, PHILADELPHIA, PENNA.

More in Your Favor
—with
Mel-Rock Air Washers

MEL-ROCK Air Washers possess many exclusive points of advantage, which are of high value. For instance:

EACH CAPACITY is made in from four to seven different proportions, so that any space and head-room may be accommodated.

MEL-ROCK Eliminator Systems are made in batteries, riveted at the factory. This saves you considerable time and money in setting up.

MEL-ROCK Mist Nozzles discharge a greater volume of mist, at low pressure.

MEL-ROCK stands for the very highest development in air-washing efficiency and economy.

Send for descriptive catalog.

TO AGENTS—There is still some good, exclusive territory open. Write for particulars.

MELLISH-HAYWARD COMPANY
213 West Austin
CHICAGO

BUFFALO SERVICE

FORM 78A 100M 6-11-20

CHICAGO AND NORTH WESTERN RAILWAY COMPANY

The Pioneer Line West and Northwest of Chicago.

CHICAGO NORTH WESTERN LINE

Antigo, February 14, 1921.

RECEIVED FEB 21 1921 CHICAGO OFFICE

Buffalo Forge Company,
563 - W. Washington Blvd.,
Chicago, Ill.

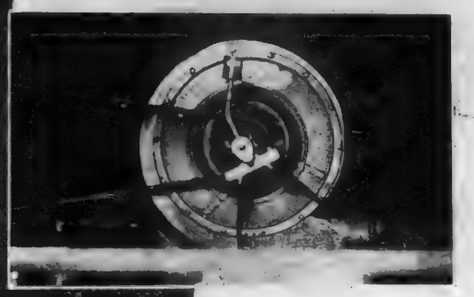
Gentlemen:-

I am sending under separate cover, photograph of Buffalo Fan now in use at our Kaukauna Shops and also am attaching a letter from Mr. Slater, which is some information relative to years of service.

Very truly yours,

C H Perry

Division Engineer.



KAUKAUNA, February 18, 1921.

Mr. Perry:

I am sending you herewith, a photograph that was taken of the Buffalo Fan, which has been in use at Kaukauna for upwards of 28 years. This fan was installed right after the Machine Shop was destroyed by fire, which to the best of my recollection was on January 1, 1893.

Enc. 5

F Slater

28 Years Old And Still Running

BUFFALO FORGE CO.
BUFFALO, N.Y.

"Buffalo"

Chillicothe, Mo.—Chillicothe is agitating the proposition of establishing a central heating plant, being influenced by the operation of the plant in Excelsior Springs which has been in successful operation for the last 10 or 12 years.

New Philadelphia, O.—A new steam heating franchise in favor of the Ohio Service Company, to be in effect from September 1, 1921, to June 1, 1922, has been introduced in the city council, being similar to the one passed last August for a similar period, with the exception of the provision for the purchase by the company of the meters installed by the customers served with steam heat. The rate is the same as last year, 75 cents per 1000 lbs. of condensation.

Tuscola, Ill.—Application has been made to the Illinois utilities commission by the Central Illinois Public Service Company for permission to discontinue its heating service in Tuscola. The company served notice some time ago that it did not expect to furnish heat from its plant the coming winter. The company is already dismantling its power and heat plant.

New Incorporations.

Universal Valve Co., New Britain, Conn., capital $25,000, to manufacture valves, fittings, etc. Incorporators: E. P. Burns, M. C. and George DeWitt, all of New Britain.

Sun Heater Co., Boston, Mass., capital $200,000, to deal in heating, lighting and power supplies. Incorporators: Howard J. Bowman, Francis L. Travers and Rose L. Travers, all of Boston.

Ampere Boiler & Tank Co., East Orange, N. J., incorporated to manufacture boilers, tanks, etc. Among the principals is Elwood B. Hendricks.

Domestic Heating & Lighting Co., Galesburg, Ill., has been organized by Delia Caldwell, A. E. Caldwell and C. E. Caldwell to conduct a heating and lighting business. Quarters have been opened at 69 East Simmons Street.

Valley Plumbing & Heating Co., Saginaw, Mich., capital $5,000, to conduct a heating and plumbing contracting business.

John P. Smith, Inc., Philadelphia, Pa., organized to manufacture heating equipment, piping, boilers, etc. Incorporators: John P. Smith, Franklin S. Morehouse and Joseph S. Shusted.

American Heater Corporation, St. Louis, Mo., capital $250,000, has been reorganized with a capital stock of $250,000. The new officers are: President, Norman Jones; vice-president and treasurer, W. F. Stewart; secretary, W. F. Meier; sales manager, Harry F. Tabler. Mr. Stewart, who organized the original company, designed a number of the patented features of the automatically-controlled instantaneous water heaters manufactured by the company, while Mr. Tabler, was connected for many years with the D. & T. Mfg. Co., of St. Louis, manufacturer of the D. & T. tank-in-basement method of water heating. The new president of the company, C. Norman Jones, is chairman of the board of directors of the Title Guaranty Trust Company, St. Louis.

Miller Plumbing & Heating Supply Co., Chicago, capital $45,000, to manufacture and deal in supplies for the heating, plumbing and milling trade. Incorporators: Milton Miller, Samuel Miller and Harry H. Miller.

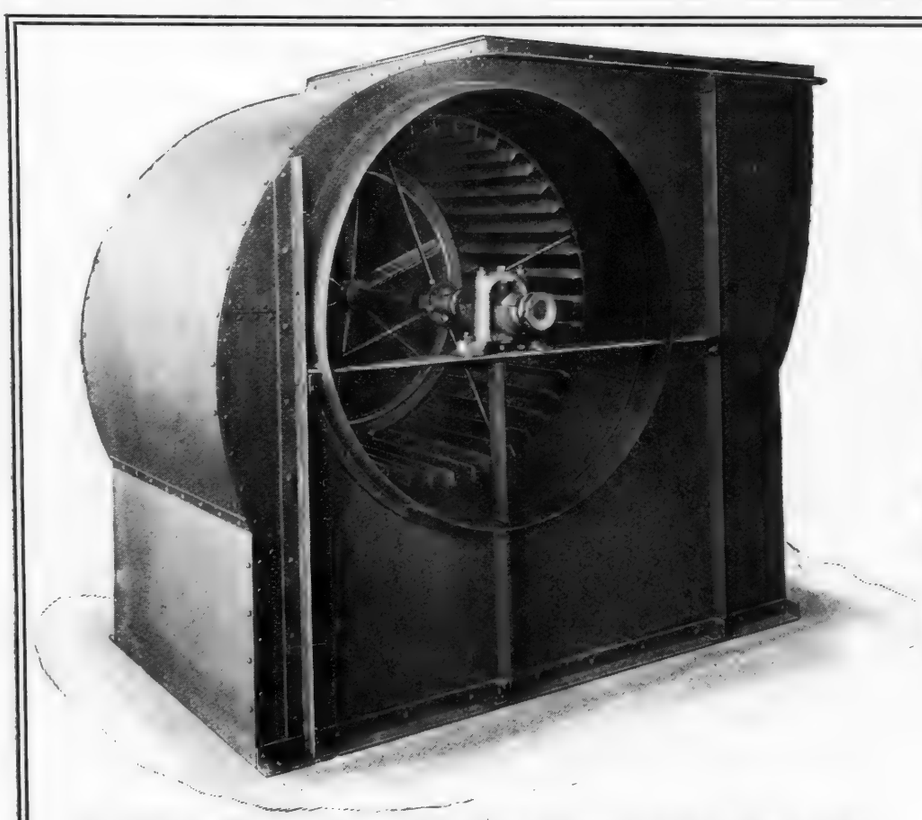
New Firms and Business Changes.

Associated Commercial Engineers, 96 Fifth Avenue, New York, is the title of a new engineering organization composed of C. R. Rothwell, A. S. M. E. and M. William Ehrlich, A. S. H. & V. E. The new firm will undertake the mechanical equipment for plants and buildings and will also handle electric pumps for all services, automatic condensation pumps, vacuum traps for radiators, return valves for vapor heating, graduated valves and vapor specialties, low-pressure return-to-boiler traps, etc.

Hygienic Heating and Ventilating Co., Chillicothe, Mo., has recently purchased a site in that city on which it will build a new plant.

Contracts Awarded.

Carstens Bros., Ackley, Ia., heating and ventilating and electric work for the Theodore Roosevelt High School. The company's bid for the heating and ven-



CAREFUL
CONSERVATIVE
Engineers
and
Architects
ARE SPECIFYING
Hackney
"V" Blade
Blowers

Effectiveness
AND
Rigid Construction
The Reason

HACKNEY MANUFACTURING COMPANY
SAINT PAUL, MINN.

PORTION OF MAIN SALES FLOOR
GLADDING DRY GOODS CO., Providence, R. I.
Since 1766
J. Frederick Hall, Architect

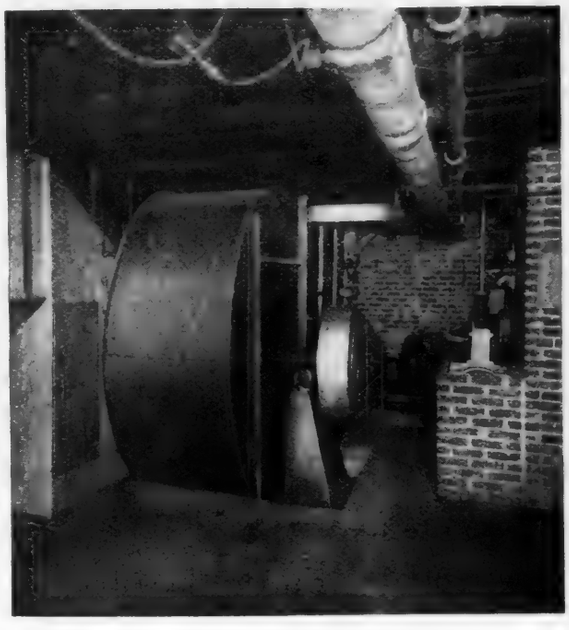
SIROCCO

The oldest mercantile establishment in the United States, yet a thoroughly modern department store, was quick to recognize the value of pure cool air for summer weather and pure, humidified and tempered air for winter.

They say: "Without the A B C Air Washer Fan installed in our store, it would have been utterly impossible to keep the store comfortable for our employees and customers."

The A B C Air Washing and Cooling Fan combines the work of the centrifugal fan, the air washer and the pump required for circulating water in a separate washer; and does this with a less amount of power and with material reductions in maintenance and attendance costs.

Our bulletin "ABC Air Washing and Cooling Fan," will be sent to those interested.



A. B. C. Air Washing and Cooling Fan at Gladding Dry Goods Co.

American Blower Company
Detroit, Mich.

tilating work was $106,473, and for the electric work, $7,484.

Waterloo, Ia.—Bids were received as follows for the heating and ventilation of the new High School building in Waterloo, covering installations in the main building and the two rear wings:

American Heating Co.,

	Main Bldg.	Rear Wings.
Superior, Wis.	122,175	3,275
Carstens Bros.	106,473	3,300
D. F. Edwards Heating Co., St. Louis.....	111,480	2,700
Industrial Heating & Eng. Co., Milwaukee..	122,850	3,600
H. Kelly & Co.....	120,000	3,200
M. J. O'Neil, St. Paul...	126,947	2,600
Peters, Eichler Heating Co., St. Louis.....	121,210	2,351
Quest & Smith.....	113,414	1,900
Ryan Plumbing & Heating Co., Davenport....	124,818	
Sodemann Heat & Power Co. St. Louis.....	112,127	2,537
Western Heating Co...	114,320	3,000
Electric Work—		
Carstens Bros.	7,484	500
Colo & Sweetman, Waterloo	8,642	564
Commonwealth Electric Co., St. Paul	9,235	687
Waterloo Electric Co....	8,235	242

Benjamin F. Shaw Co., Wilmington, Del., installing boiler house, steam piping and auxiliaries, and an underground system of steam distribution for the Delaware State Hospital at Farnhurst.

WANTED

Advertisements under this heading, $2.00 per inch, payable in advance. A 1-in. advertisement contains 35 words. To secure insertion copy must be received not later than the 20th of the month preceding date of issue.

PURCHASER or MANUFACTURER interested in buying patent rights or in producing a new radiator bracket, patented in the United States, Canada, and England. Address inquiries to Harry Pickup, 46-48 Goswell Road, London, England.

WANTED: A sales engineer or concern with knowledge of heating and ventilating apparatus, to distribute two types of unit heaters. Must be able to do drafting, cost-keeping, etc. Good salary and commission to those who can produce results. Box "U," care of HEATING AND VENTILATING MAGAZINE.

WANTED—Heating salesman of large calibre. Can use only men of unquestionable sales record which must be produced. Salary or commission will be attractive to men who can deliver. Williams Radiator Company, Railway Exchange Building, St. Louis.

WANTED.

Heating and Ventilating Salesmen.

If you can qualify as a good salesman for our Products, we have an excellent opportunity for you. Have you an acquaintance with architects, engineers, and contractors—have you sold heating and ventilating systems? If so, you can capitalize your acquaintance and experience. We have a proposition that is equivalent to putting you in business for yourself.

Moline Heat salesmen who have been operating for years, will furnish sufficient evidence of the possibilities. You need not be a technical engineer, so long as you know the fundamentals of good heating and ventilating and are a good salesman.

The Univent is now becoming recognized by leading Architects and Engineers as the greatest step in modern ventilation. It is now being specified for schools and public buildings from Maine to California.

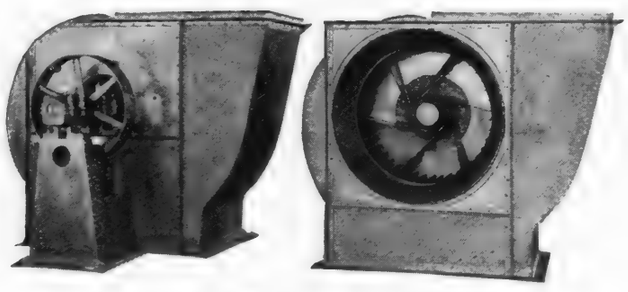
Also manufacturers of the well-known Moline System of Steam Circulation on the market for the past fourteen years and in many parts of the country is well known and widely used by leading Architects and Contractors; also manufacturers of other products identified by heating and ventilating. See our advertisement on page 15.

Write at once as territory is fast closing up.

MOLINE HEAT,
Moline, Illinois.

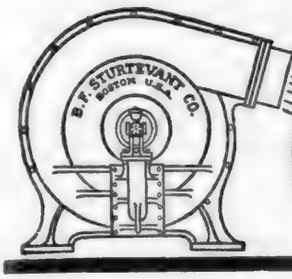
LEHIGH

Fans
Air Washers
Dust Collectors
Ventilators



Write for Catalog and Complete Data Book

HERSH BROTHERS CO.
655 Mill Street
ALLENTOWN, PENNSYLVANIA



Sturtevant

REG. U.S. PAT. OFF.

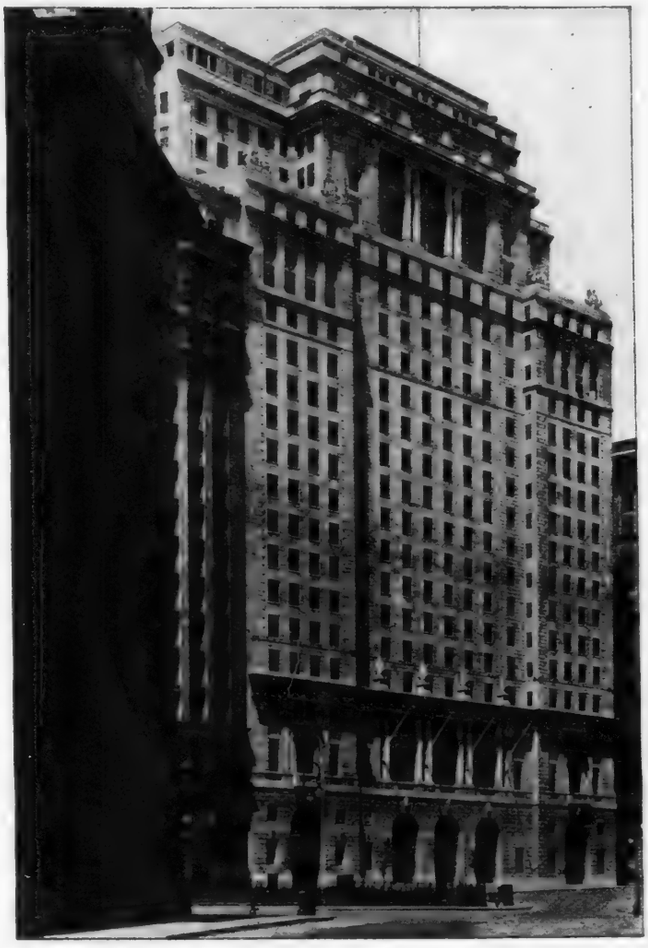
PUTS AIR TO WORK

THE CUNARD BUILDING is a product of quality throughout. It ranks foremost among important buildings of the country in architecture, construction, decoration and mechanical equipment.

Architectural and Engineering skill have co-operated to make a lasting monument to a great business enterprise. The searching analysis of products leading to the specification of Sturtevant apparatus is a vindication of the quality and service claimed for

Sturtevant Ventilating Equipment

The same service and assurance of quality are available to architects throughout the country. We maintain twenty-four branch offices as listed below where you will find qualified engineers ready to serve you. Special research problems are gladly undertaken at our Hyde Park headquarters.



Benjamin Wistar Morris, *Architect;* Carrère & Hastings, *Consulting Architects;* Meyer, Strong & Jones, Inc., *Mechanical Engineers*

The following brief facts indicate the size and importance of the Sturtevant ventilating installation in the Cunard Building. There are eight separate systems, divided as follows: 1. Mechanical plant in sub-basement. 2. Cunard quarters in basement and first floor. 3. Cunard quarters on second and third floors. 4. Mechanics and Metals National Bank in basement, second and third floors. 5. Vaults in basement and sub-basement, and three systems to ventilate all toilet and locker rooms throughout the building.

B. F. STURTEVANT COMPANY

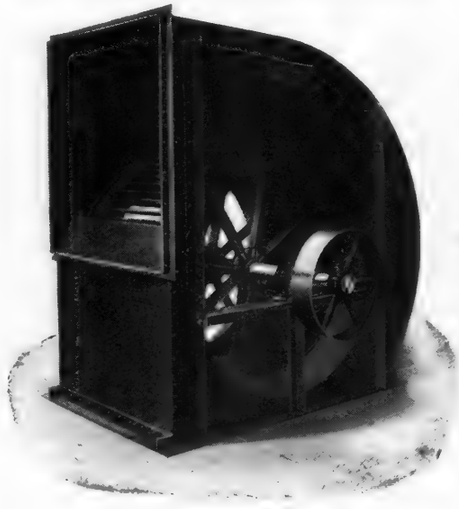
HYDE PARK, BOSTON, MASS.

STURTEVANT BRANCH OFFICES

ATLANTA, GA. 306 Walton Bldg.
BOSTON, MASS. 555 Mass. Trust Bldg.
BUFFALO, N. Y. 100 Bedford Ave.
CHICAGO, ILL. 530 So. Clinton St.
CINCINNATI, OHIO 604 Provident Bank Bldg.
CLEVELAND, OHIO 330 Guardian Bldg.
DALLAS, TEXAS 3411 Knight St.
DETROIT, MICH. 406 Marquette Bldg.
HARTFORD, CONN. 36 Pearl St.
KANSAS CITY, MO. 3830 Park Ave.
LOS ANGELES, CALIF. 411 Hollingsworth Bldg.
MINNEAPOLIS, MINN 804 Met. Life Bldg.
NEW YORK, N. Y. 52 Vanderbilt Ave
PHILADELPHIA, PA. 135 No. Third St.
PITTSBURGH, PA. 711 Park Bldg.
ROCHESTER, N. Y. 1024 Granite Bldg.
ST. LOUIS, MO. 2086 R'y Exchange Bldg.
SALT LAKE CITY, UTAH 818 McIntyre Bldg.
SAN FRANCISCO, CALIF 759 Monadnock Bldg.
SEATTLE, WASH. 1105-1106 White Bldg.
WASHINGTON, D. C. 1006 Loan & Trust Bld.
B. F. STURTEVANT CO. OF CANADA LTD. GALT, ONT.
MONTREAL 404 New Birks Bldg
TORONTO 210 Lumsden Bldg

Buckeye Multiblade Fans

are made especially for low pressure Heating and Ventilating work. They are giving perfect satisfaction.



CORRECT DESIGN, HEAVY CONSTRUCTION, NOISELESS OPERATION, WORKMANLIKE FINISH, HIGHEST EFFICIENCY.

Our Engineering Department is maintained for the purpose of assisting Engineers, Architects, etc., in planning efficient Heating and Ventilating Systems for all buildings.

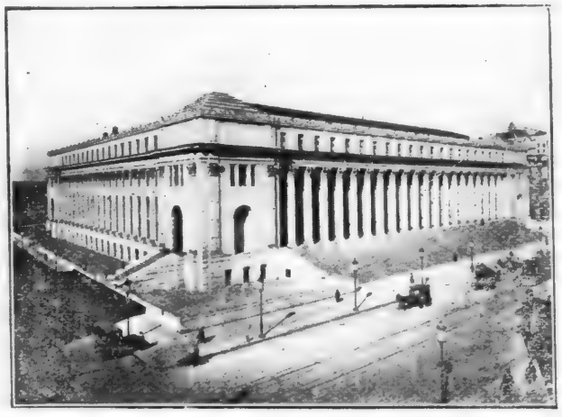
THIS DEPARTMENT IS FREE TO YOU

We also manufacture a complete line of Disc, Cone and Steel Plate Fans:

Write Department D

BUCKEYE BLOWER CO.

COLUMBUS, OHIO



New York Post Office Building

Equipped throughout with Batteries of Massachusetts Fans

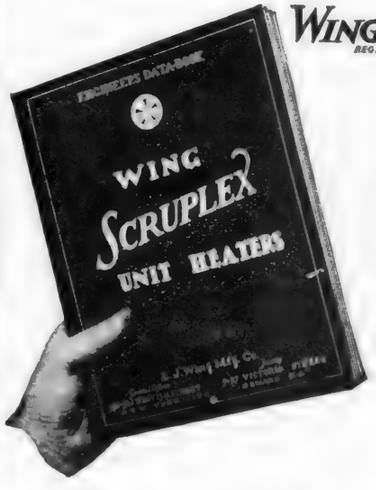
Massachusetts

Modified "Squirrel Cage" Fans

possess the distinct and unusual advantage of "great capacity in small space," and this great capacity is obtained, not at a sacrifice of efficiency, but at higher efficiency than is possible with other forms of fans. For a given volume, it is smaller, cheaper in first cost and in cost of operation. The smaller wheel is driven at a higher rotative speed than was economical with the old paddle-wheel type; the smaller wheel at a higher speed means smaller motor and engines when direct connected, and these are also cheaper in first cost and operation.

MASSACHUSETTS BLOWER CO., Watertown, Mass.

Get This New Book on Unit Heaters



WING-SCRUPLEX REG. U.S. PAT. OFF.

UNIT HEATERS

Present the best method of heating any mill, factory, foundry, garage, etc. They confine the heat to the working area where it is needed, thereby effecting a substantial saving in coal consumption. For such buildings, cost of installation is lower than ony other heating system.

Built in Several Sizes, in Three Different Types: Floor, Ceiling and Wall Type.

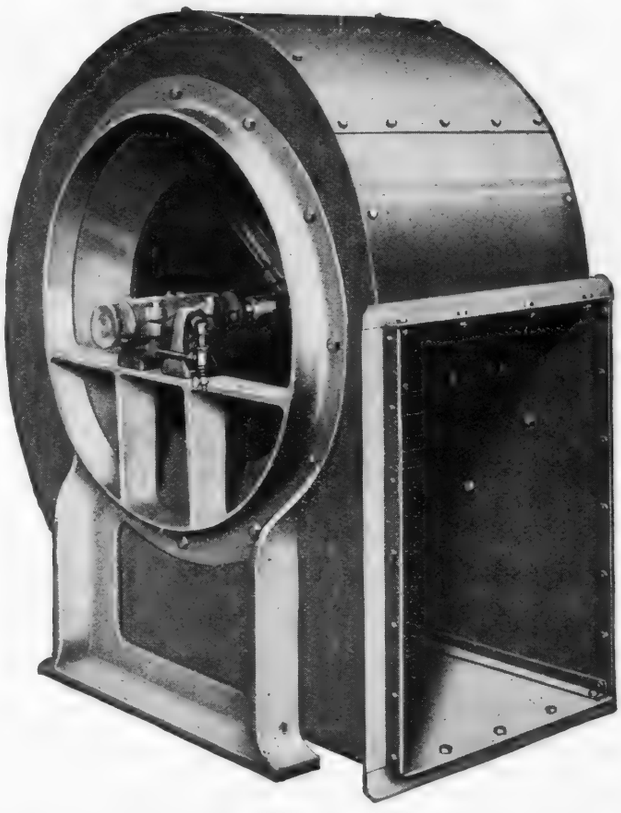
L. J. Wing Mfg. Co.

Fans and Blowers (all types)
Damper Regulators Small Turbines

HUDSON and 13th STREETS, NEW YORK CITY

The New York Blower Company

SERI-VANE FANS



Cut shows our standard type "C" Seri-Vane Fan as made in all sizes to and including number six—wheel diameter 36 inches. You will note fan is reversible as to both hand and discharge. Any special angular discharge can be readily attained with a minimum of labor. We stock all sizes of these fans so can ship any hand or discharge within twenty four hours from receipt of order at our factory.

Are you using our Mushroom Ventilators? If not, write for prices and literature and save labor of your men and your money.

THE NEW YORK BLOWER COMPANY

513 Transportation Building

CHICAGO, ILL.

Factory: Laporte, Ind.

For prompt service, write nearest sales office

THE DOUGLASS HUMIDIFIER

Is attached directly to the steam heating system

DISCHARGES DRY STEAM NOISELESSLY

Gives satisfactory results in any type of building equipped with steam.

Inexpensive to install

Will not get out of order

No attention required

No maintenance expense

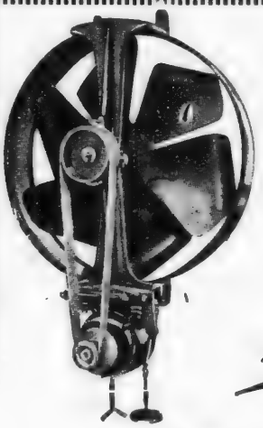
Made in various sizes and types to suit all conditions and requirements.

May be installed in the plenum chamber of a ventilating system.

Operates perfectly with or without automatic control.

Illustrated catalogue sent on request.

THOMAS J. DOUGLASS & CO.,
441 N. Dearborn St.,
Chicago, Ill.



A Variable Speed
Disc Fan
A Better Fan at a Lower Price
That's what you get if you purchase
THE
Bayley
JUNIOR
DISC FAN

The Fan with variable speed control and a constant speed motor. No rheostat, or troublesome brush shifting device. Simply vary the belt tension to vary speed from 2½ to 100% of full speed. A plain, highly efficient, common sense fan that is as near trouble proof as a fan can be.

PATENTED VENTILATED PULLEY
with a cooling draft of air passing through the core prevents heating or burning of belt. Acid proof belt guaranteed for one year. *Send for Bulletin today.*

BAYLEY MFG. CO., Dept. E, Milwaukee, Wis.

DESCRIPTION

Instantaneous zero setting without use of key. Jewelled bearings. Enamel dial boldly figured. Threaded socket for attaching to foot, permitting use in otherwise inaccessible places. English sole leather carrying case. Calibration charts for velocities up to 3,000 feet per minute.

Tycos
Anemometer

Measures air currents of 100 to 3,000 feet per minute in mines, tunnels, shafts, airways, etc.

Taylor Instrument Companies
ROCHESTER, N. Y.
There's a *Tycos* or *Taylor* Temperature Instrument for every purpose
768

1 The Cunard Building
2 The Townhall
3 Bankers' Trust Building
4 Seaboard National Bank

W
WESTINGHOUSE ELECTRIC

New York's finest

are Westinghouse Equipped

Should you select a list of New York's newest and finest buildings you would find all of them users of Westinghouse motors and control.

The four shown here would be on your list, the Cunard Building being one of the most costly structures in the United States and New York's latest skyscraper, while the remaining three are architectural triumphs.

Below are listed a few more of the most recent buildings erected in New York; all are equipped with Westinghouse apparatus.

Each one of these installations is a guarantee of Westinghouse reliability.

Mt. Sinai Hospital	Wurlitzer Bldg.
358 Fifth Avenue Bldg.	Ligget, Winchester, Ley Bldg.
Columbia Trust Bldg.	Guaranty Fifth Avenue Bldg.

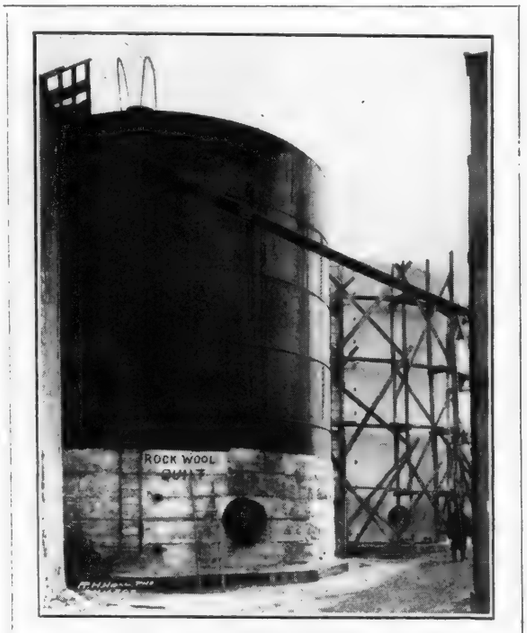
Pennsylvania Hotel

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY
East Pittsburgh, Pa.

Sales Offices in all Principal American Cities

Westinghouse

HEATING - VENTILATING ELEVATOR & PUMPING EQUIPMENT



HIGH TEMPERATURE STEEL TANKS

ADAPTABILITY

OF

Banner Rock Wool Quilt

100% FIRE PROOF

HEAT INSULATION

As is shown by the above illustration, Banner Rock Wool Quilt is adaptable for insulating large tanks, tank cars, water and oil stills as well as small household boilers, heaters and such units.

Comparative tests have demonstrated no material has the wide range of adaptability as has this unique material.

Our Engineers will cheerfully co-operate with you in helping solve your insulation problems.

BANNER ROCK PRODUCTS CO.

MANUFACTURERS OF

Heat and Cold Insulation

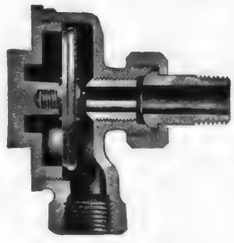
ALEXANDRIA INDIANA

HEATING IDEAL EQUIPMENT TRADE MARK

IDEAL TRAPS

Make Vapor and Vacuum Heating Systems

Efficient and Economical

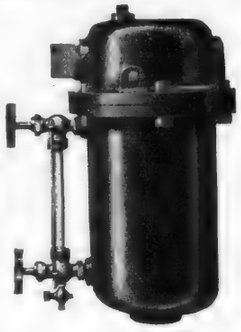


The Ideal Thermostatic Radiator Trap

Is built for long, hard service. Its rugged diaphragm withstands corrosive elements and excessive pressures. A reliable trap unaffected by sediment or scale.

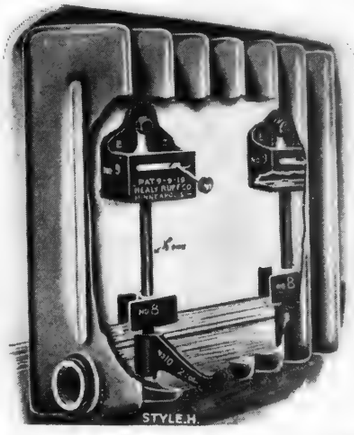
The Ideal Alternate Return Trap

Assures a steady water line by returning condensation to the boiler against pressure. Freely removes all air, and makes vapor heating safe.



Ideal Heating Equipment Co.

1897 E. 90th St., Cleveland, Ohio.



EZ

Radiator Hanger

Write for Bulletin

BASE BOARD ADJUSTMENT
HORIZONTAL "
VERTICAL "

ONE BOLT IN THE WALL

Both styles made for Wall and Column Radiation.

Very Reasonable in Price.

Agents in a good many Cities

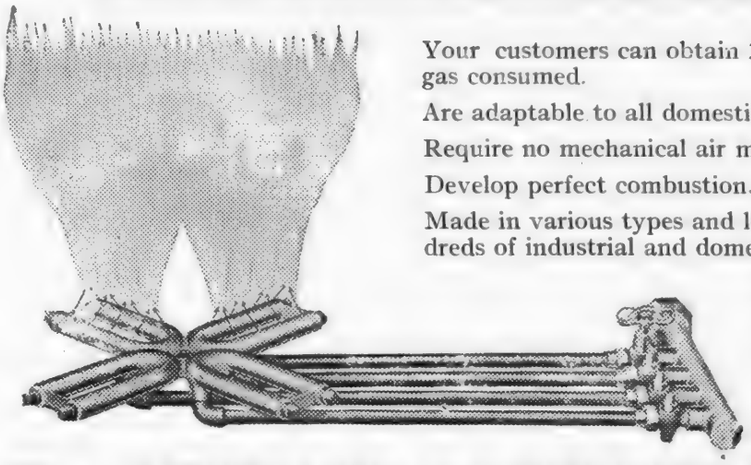
HEALY-RUFF CO.

MINNEAPOLIS, MINN.

Manufacturers of Heating Appliances and Heating and Plumbing Contractors, Who Are Busy These Days

HAVE ADOPTED

Barber Patented Gas Burners



Your customers can obtain 25% to 40% more heat from the gas consumed.

Are adaptable to all domestic heating appliances.

Require no mechanical air mixers.

Develop perfect combustion.

Made in various types and layouts to specifically handle hundreds of industrial and domestic heating problems.

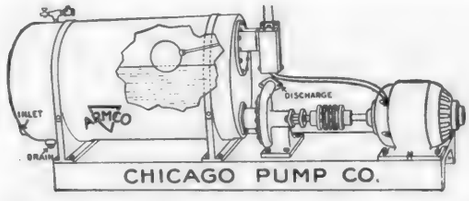
Can be quickly installed or removed from any appliance in a few moments if the gas pressure is entirely shut off.

Write Us for Our New Catalog Showing Complete Line and New Attractive Prices

The CLEVELAND GAS BURNER & APPLIANCE CO.

3702-04 Superior Avenue, Cleveland, Ohio

Quick
and Easy
THREADING or cutting large pipe with geared pipe tools is no longer a long, tedious job. Two men, a "TOLEDO" No. 4 geared Threader and a "Toledo" Power Drive, can complete a thread on 12-inch pipe in LESS than 15 minutes! Get circular.
The Toledo Pipe Threading Machine Co.
TOLEDO, OHIO
New York Office:
50 Church St., New York City
TOLEDO DRIVE
PORTABLE POWER



Condensation Pump and Receiver

OF

Highest Possible Quality

AT

Far Lower Price

Manufacturing electric condensation pumps and receivers has nearly always meant special assembling.

The result has been that good condensation pumps have been high priced. In addition, renewal parts are costly and delays are experienced in obtaining them.

In order to overcome the handicaps of the present method, of which those mentioned are only two, we have evolved a new plan of quantity production and standardization for Condensation Pump and Receiver Units.

The outfits we make will be of the highest possible quality and far lower in price than especially built units. Renewal parts will be easily obtainable and replacements made with the least possible delay for the user of this equipment.

Write Us for Full Details. Ask for Our New Catalog and Table of Pumping Engineering Data

CHICAGO PUMP COMPANY

2325 Wolfram St. **Chicago, Ill.**

Whitlock Instantaneous Hot Water Heaters

Type A Illustrated

HEATING SURFACE—Coils of seamless copper tubing, the ends of which are brazed to copper manifold fittings. The copper prevents contamination by rust, dirt or oil.

SHELL—Cast iron. Because of the resistance of cast iron to rust the life of the heater is practically unlimited.

ASSEMBLY—The coils are supported in the shell by means of our patented system of clamping and bracing which prevents vibration or abrasion of the tube, at the same time allowing free expansion and contraction with temperature changes.

Built in sizes from 50 to 5000 gal. and larger heating capacity per hour. Bulletin No. 6 sent on request.

SEE OUR CATALOGUE IN SWEET'S

The Whitlock Coil Pipe Company, Hartford, Conn.

New York Philadelphia Chicago Boston Buffalo

"Whitlock Heaters Have Everlasting Copper Tubes"

MARSH RE-ENFORCED PACKLESS VALVES

Quick Opening

Note General Lines Carefully

The **ONLY Packless** and **Modulated** Valves in which the **Packless Feature,** although a **positive seal within itself** and **practically indestructible,** is, through a packing cushion and a very heavy special spring, **automatically re-enforced,** providing **two or double, independent, positive,** bonnet seals at **all times.**

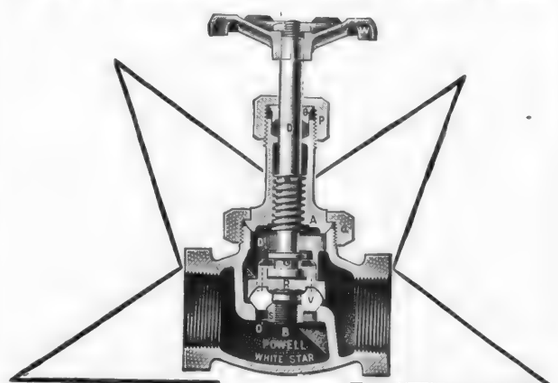
These valves will withstand high pressures and, therefore, are of **superior value** for **vacuum** and **low pressure service.**

We specialize on high grade Radiator Valves and furnish the largest line of any company in the business

Printed matter and prices on application

MARSH VALVE CO., Erie, Pa.

POWELL VALVES



DOUBLE-LIFE DISC of non-corrosive white "POWELLIUM"

SLIP-ON Disc Carrier protects the unused face of disc

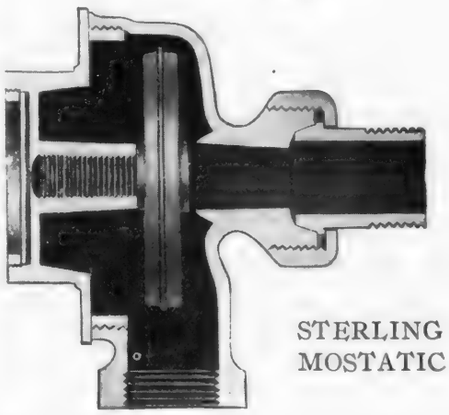
Exclusive claims to SUPERIORITY of the "WHITE STAR" VALVE

Ask your dealer for Powell Valves or write us

The Wm. Powell Company

Cincinnati, Ohio

STERLING SYSTEMS



STERLING THERMOSTATIC TRAP

The Sterling Thermostatic Trap is steam tight, yet will free the unit of air and water.

Note the vertical self cleaning seat.

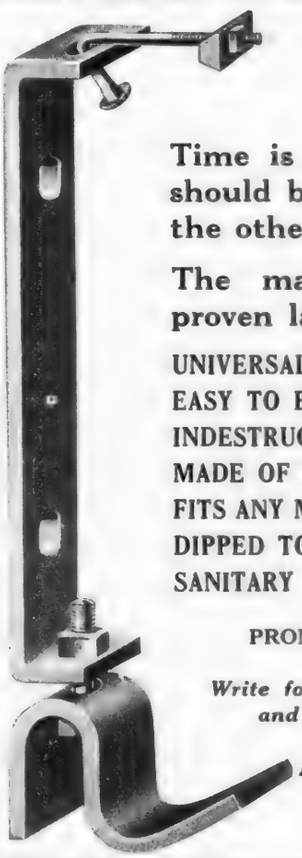
Diaphragm closes against the steam, not with it.

We also manufacture
Return Traps—Air Line Valves—Graduated Supply Valves —Air Eliminators—Damper Regulators—Strainers

STERLING ENGINEERING COMPANY
Milwaukee Wisconsin

GLEOCKLE WALL RADIATOR BRACKET

(Patented)



Time is money and one should be saved as well as the other.

The many features are proven labor savers.

UNIVERSAL ADJUSTMENT
EASY TO ERECT
INDESTRUCTIBLE
MADE OF WROUGHT IRON
FITS ANY MAKE WALL RADIATOR
DIPPED TO PREVENT RUSTING
SANITARY

PROMPT SHIPMENTS

Write for Descriptive Booklet and Trade Discounts

A. F. Gleockle, Jr.
415 Bay St.
ROCHESTER, N. Y.

PATTERSON

P **Preferred by those who recognize true merit in a water Heating System**

A Automatic, requiring no adjustment — and no attention whatever

T Temperature is uniform under all variations of service

T Time is saved by having an unlimited supply of scalding **hot water**

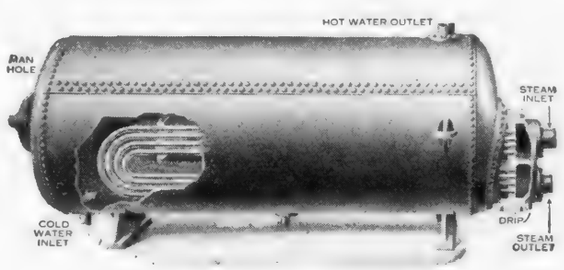
E Efficient and economical. Materials and workmanship unexcelled

R Reliable with nothing to get out of order and cause trouble and delay

S Steam may be either exhaust, high or low pressure live steam

O Operating cost is next to nothing no difference how long in use

N Noted for supplying **Hot Water** for domestic or industrial purposes



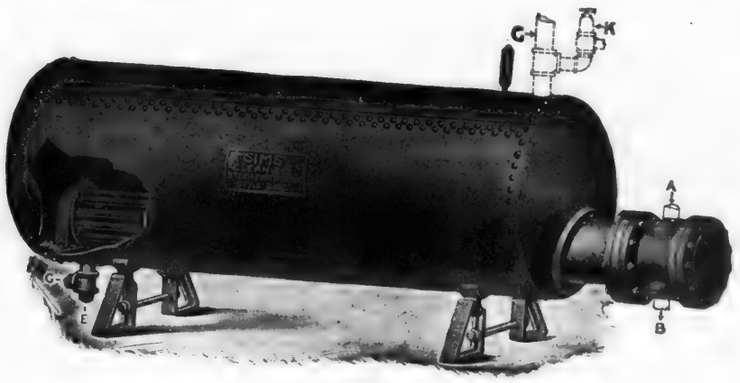
The Patterson System of Water Heating for any Service

Patterson-Kelly Co.
23 Dey St. New York

Meet that Peak Demand for Hot Water

WITH A

Sims Clean E-Z Steam Tube Heater



For Hotels, Apartment Buildings, Hospitals, Y. M. C. A. Buildings, Schools, etc.

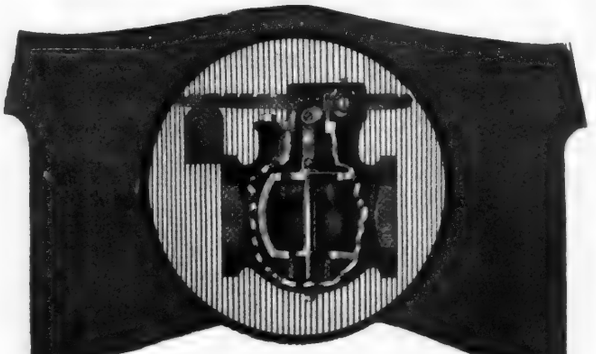
For Live or Exhaust Steam

Especially Designed for Supplying Large Quantities of Hot Water

Send for tables showing heat capacities using steam at various pressures

"We keep others in hot water"

THE SIMS CO., 18th St., Erie Pa.



A Back Pressure Valve for Heating Systems

The Davis Back Pressure Valve maintains any desired back pressure on the exhaust line of a non-condensing engine for heating, drying, cooking, etc. Dependable as gravity because back pressure is maintained by a counter weight on a lever arm.

Valve is of noiseless double piston type. Construction of valve and seats is such that uneven expansion of metals will not cause binding or sticking

The Back Pressure Valve is just one of the Davis appliances that have been saving steam in heating plants since 1875. A catalog describing the complete line of Davis Valve Specialties tells about them. Write the G. M. Davis Regulator Co., 436 Milwaukee Ave., Chicago

DAVIS VALVE SPECIALTIES
STEAM SAVERS SINCE 1875

HARTMANN
RADIATOR BRACKETS

WHYS

LABOR SAVED

NO WALL STRIPS

NO BREAKAGE

NO DIRT

INEXPENSIVE

Send for descriptive circular and price list

CHARLES HARTMANN CO.
SHEET METAL CONSTRUCTORS
985 Dean St., Brooklyn, N. Y.

NONE BETTER NONE CHEAPER

AUTOMATIC ELECTRIC

Centrifugal Vacuum Pumps

ABSOLUTE GUARANTEES

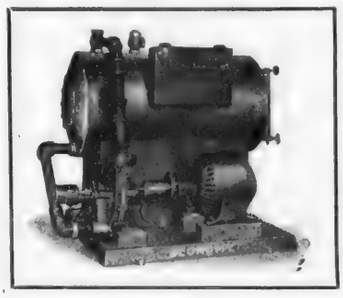


FIG. 2234-C.V.
SUITABLE 20 BOILER PRESSURE

Unit Number	Capacity Sq. Ft. Direct Ci. Radiation	Motor Horse Power	Cubic Ft. Air Per Minute	Water Capacity Gals. Min.
CV 1	2,500	½	1¾	6
CV 2	5,000	¾	4	10
CV 3	8,000	1	6	14
CV 4	15,000	1½	10	20
CV 5	20,000	2	15	25
CV 6	27,500	3	19	35
CV 7	40,000	5	24	60
CV 8	65,000	7½	40	100

ECONOMY PUMPING MACHINERY CO.

120-126 N. CURTIS ST. CHICAGO

Every Heating Engineer Knows the Advantages of Copper Over Iron

SPECIFY

DAHLQUIST

Copper Boilers

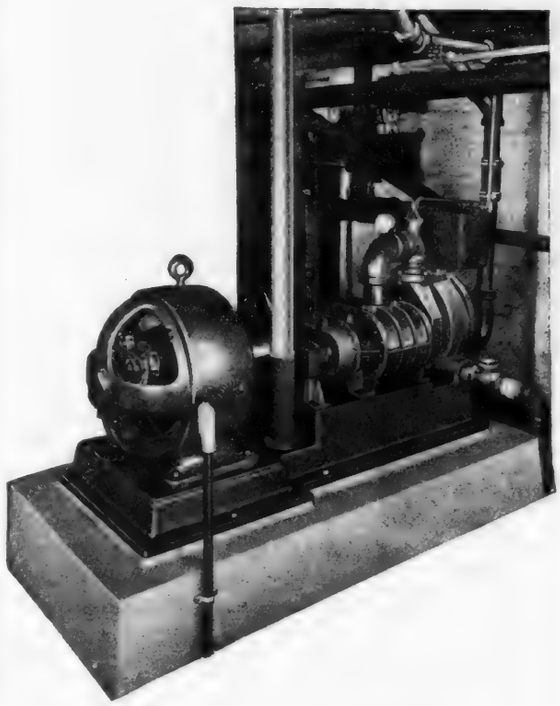
Let us figure on your requirements

DAHLQUIST MFG. CO.

40 West 3rd St. BOSTON, MASS.

CONNERSVILLE

VACUUM CLEANING SYSTEMS



Automatic Disposal of All Dust and Dirt

This feature eliminates the shutting down of the machine for the cleaning out of dust tanks or buckets as the dirt is discharged continuously into the sewer in a liquid condition direct from the separator.

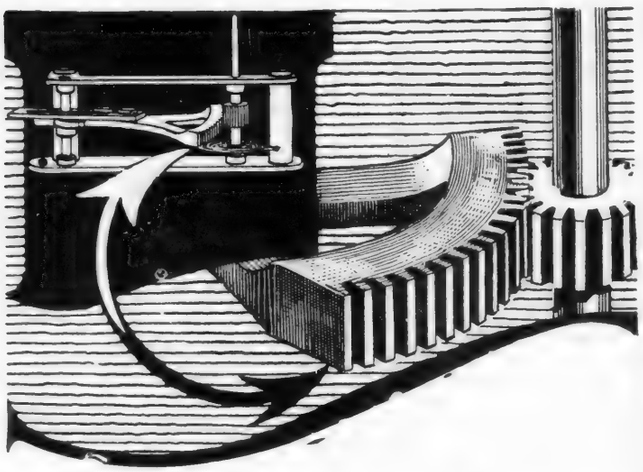
The Connersville system can be used, not only for regular cleaning, but can be used for the cleaning of swimming pools.

The unit is compact and easy to install, as the motor, pump and separator are all mounted on the same cast iron base.

There's a Connersville machine for every cleaning problem.

LANDERS, FRARY & CLARK

U. V. A. Div. Dept. C. CONNERSVILLE, IND.



Broad Surfaces Lessen Wear

Any piece of machinery operating at high speed or under stress of continuous load can be protected against wear by a broad bearing surface. The shaft of a marine engine, with its ample pillow block, as illustrated above, is only one example in hundreds.

Recognizing that constant oscillation causes wear, we have built the segment with an unusually broad face, and with pinions with corresponding width in

AMERICAN GAUGES

To insure the utmost in durability, American Gauge Segment is, furthermore, made of an extra-hard bronze alloy, while both segment and pinion shafts revolve in wear-resisting bushings of phosphor bronze.

Human ingenuity can't construct a stronger, longer-lasting gauge movement than we have created for American Gauges. Under conditions which soon rack ordinary gauges to pieces, American Gauges stand up defiantly for years.

The *individually hand-calibrated* dial, insuring *accuracy*, is another feature of American Gauges that you cannot afford to overlook.

Write today for our gauge Catalog No. 70—giving full details.

American Steam Gauge & Valve Mfg. Co.

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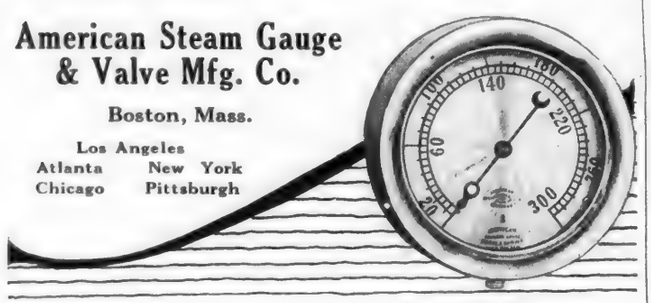

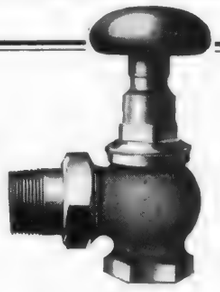

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Detroit Packless Radiator Valves are the result of years of experience in the valve manufacturing field—of a careful study of valve needs—of painstaking care on the part of our engineers.

So well do these valves qualify for efficient service—for handsome design and pleasing appearance—for complete satisfaction, that leading architects, heating engineers and master builders, the country over, recommend and specify them for jobs that require the most careful consideration.

They are made for steam, vapor and vacuum heating systems—in all necessary sizes and a variety of styles. Let us send booklet giving full information.

DETROIT LUBRICATOR COMPANY.

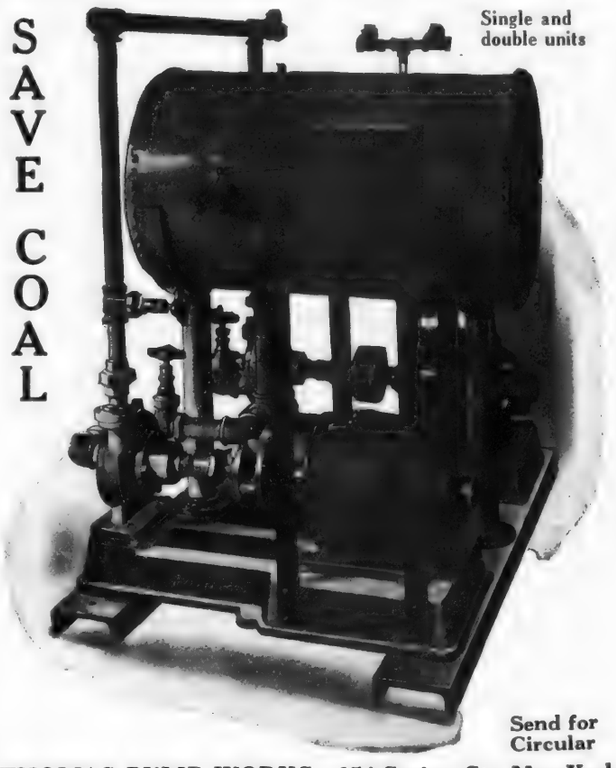
DETROIT, U.S.A.

THE THOMAS AUTOMATIC CONDENSATION UNITS

of all descriptions and sizes

SAVE COAL

Single and double units



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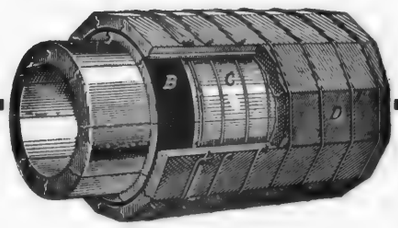
THOMAS PUMP WORKS, 154 Spring St., New York



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Wyckoff's
Improved
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Not affected by wet and dry conditions common to steam-pipe trenches. Will not rot. Absolutely water and steam tight. Each shell is wound with extra-heavy steel wire. Coated all over with the best known preservative—**Montezuma Asphalt.**

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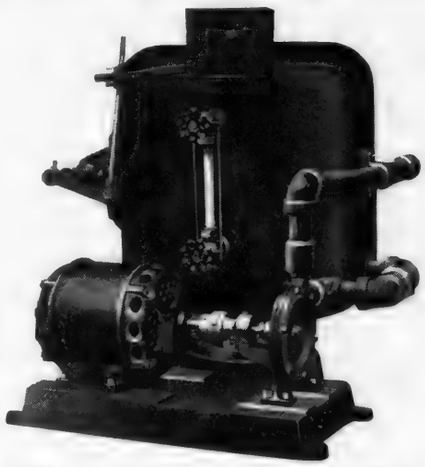
WESTERN AUTOMATIC ELECTRIC CONDENSATION PUMP and RECEIVERS



RELIABLE **SIMPLE**

A single stage pump suitable for high or low pressure ranging from 10 lbs. to 100 lbs.

The unit is very compact, mounted on cast iron base, only two pipe connections necessary when installing. The receiver is made in two sizes, of heavy cast iron. An enclosed butt contact switch is used on all pumps.

Write for Bulletin No. 220

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DAVENPORT, IOWA

Carrier Engineering Corporation

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Humidification Dehumidification Cooling
Heating Ventilation Purification

High Temperature Air Heaters for
Drying Processing Baking
up to 1000° F.

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MANUFACTURED WEATHER

$5,000,000,000
Available for Productive Enterprises

in three years if the thirty million workers of the country would save an extra dollar a week.

Billions of New Capital is literally the Need of the Hour.

In our onward march it becomes more and more imperative that new sources of capital be explored, that new classes of investors be developed.

A Government Savings Association organized in your establishment will make it possible for your employees to do their part in the great work of reconstruction.

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25c to $1000

Government Loan Organization
Second Federal Reserve District
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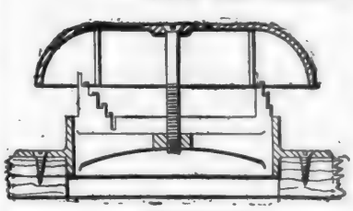
FRESH AIR for THEATRES
AND ALL AUDITORIUMS



The "Notch" Diffuser will distribute the air uniformly.

It is easily adjusted to different openings and locked.

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ALSO AISLE HOODS DAMPER AND SCREW TYPES

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Carrier Air Conditioning Co., Buffalo, N. Y.
Carrier Engineering Corporation, New York.
W. L. Fleisher Co., New York, N. Y.
Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago, Ill.
Spray Engineering Co., Boston, Mass.
Sturtevant Co., B. F., Hyde Park, Boston. Mass.
L. J. Wing Mfg. Co., New York.

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Badger & Sons Co., E. B., Boston Mass.
Griscom-Russell Co., New York.

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W. L. Fleisher Co., New York, N. Y.
Hersh Bros. Co., Allentown, Pa.
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Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago. Ill.
Spray Engineering Co., Boston, Mass.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
L. J. Wing Mfg. Co., New York.

AIR ELIMINATORS.
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AIR SEPARATORS.
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Hoffman Specialty Co., New York.

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Mellish Hayward Co., Chicago. Ill.
New York Blower Co., Chicago, Ill.
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Hackney Mfg. Co., St. Paul, Minn.
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Utica Heater Co., Utica, N. Y.

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New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F. Hyde Park, Boston, Mass.

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Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

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Buffalo Forge Co., Buffalo, N. Y.
Clarage Fan Co., Kalamazoo, Mich.
Hackney Mfg. Co., St. Paul, Minn.
Hersh Bros. Co., Allentown, Pa.
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Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
L. J. Wing Mfg. Co,. New York.

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Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.

Ounce Graduated.
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Marsh & Co., Jas. P., Chicago. Ill.
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McAlear Mfg. Co., Chicago, Ill.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.
Taylor Instrument Co., Rochester, N. Y.
Webster & Co., Warren, Camden, N. J.

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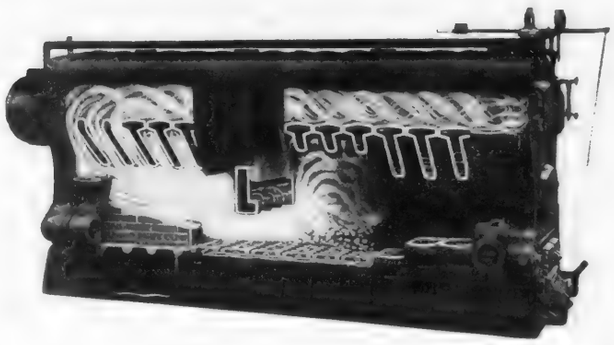
Wright-Austin Co., Detroit, Mich.

Imperial Super-Smokeless Boilers

Sectional View of an Imperial Super-Smokeless Boiler



Arrows Indicate Inlet of Air to Hot Blast Chamber

Burn Soft Coal Without Smoke

Anti-smoke ordinances have no terrors for Imperial Super-Smokeless Boilers because they burn the smoke and utilize those potential heat units that ordinary boilers permit to go out the chimney.

This smoke and gas consuming ability makes these boilers very economical in fuel consumption, and at the same time highly efficient in generating steam, despite the coldest weather.

The boiler design embodies a scientific idea, very similar to the Bunsen Burner principle. The coal is burned on a flat grate in the usual manner; then right at the heart of the fire, fresh air is allowed to enter the flame. The result is an intensely hot, blue-white flame that swirls forward and back over the heating surfaces, giving unusual heating capacity at low cost.

Imperial Super-Smokeless Boilers are in service in all large cities, making remarkable records for fuel economy. Let us send you a list of installations and descriptive catalog containing useful data.

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UTICA, New York

218-220 West Kinzie St., Chicago, Ill.

Branches in Principal Cities

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Patterson-Kelley Co., New York.
Ross Heater & Mfg. Co., Buffalo, N. Y.
Sims Co., Erie, Pa.
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Patterson-Kelley Co., New York.
Ross Heater & Mfg. Co., Buffalo, N. Y.
Simmons Co., John, New York.
Sims, Co., Erie, Pa.
Whitlock Coil Pipe Co., Hartford, Conn.

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Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

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Sarco Co., New York.
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Ideal Heating Equipment Co., Cleveland, O.
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Illinois Malleable Iron Co., Chicago, Il.
Marsh & Co., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Moline Heat, Moline, Ill.
Sarco, Co., New York.
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Carrier Engineering Corporation, New York.
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Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago Ill.
Spray Engineering Co., Boston, Mass.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

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Atmospheric Conditioning Corp., Phila., Pa.
Carrier Engineering Corporation, New York.
W. L. Fleisher Co., New York, N. Y.
Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass,

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Taylor Instrument Cos., Rochester, N. Y.
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Ric-Wil Co., Cleveland, O.
Wyckoff & Sons, A., Elmira, N. Y.

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Toledo Pipe Threading Machine Co., Toledo, O.

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McAlear Mfg. Co., Chicago, Ill.
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Nash Engineering Co., So. Norwalk, Conn.
Plant Eng'g & Equipment Co., New York.
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Yeomans Bros., Chicago, Ill.
Young Pump Co., Michigan City, Ind.

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Chicago Pump Co., Chicago, Ill.
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Sprague Electric Works, New York
Thomas Pump Works, New York.
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Chicago, Pump Co., Chicago, Ill.
Economy Pumping Machinery Co., Chicago, Ill
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Thomas Pump works, New York.
Thompson Mfg. Co., Des Moines, Ia.
Trane Co., La Crosse, Wis.
Western Engineering Co., Davenport, Iowa.
Wright-Austin Co., Detroit, Mich.
Yeomans Bros. Co., Chicago, Ill.

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Nash Engineering Co., So. Norwalk, Conn.
Thomas Pump Works, New York.
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United Vacuum Appliance Division, Connersville, Ind.
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Buffalo Steam Pump Co., Buffalo, N. Y.
Ideal Heating Equipment Co., Cleveland, O.
Nash Engineering Co., So. Norwalk, Conn.
Plant Engineering & Equipment Co., New York.

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Yeomans Bros., Chicago, Ill.

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Buffalo Steam Pump Co., Buffalo, N. Y.
Chicago Pump Co., Chicago. Ill.
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Economy Pumping Machinery Co., Chicago, Ill.
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Yeomans Bros., Chicago, Ill.

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BOILER-FEED.

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Thomas Pump Works, New York.
National Regulator Co., Chicago, Ill.
Wright-Austin Co., Detroit, Mich.

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Moline Heat, Moline, Ill.
National Regulator Co., Chicago, Ill.
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Sterling Engineering Co., Milwaukee, Wis.
Trane Co., La Crosse, Wis.
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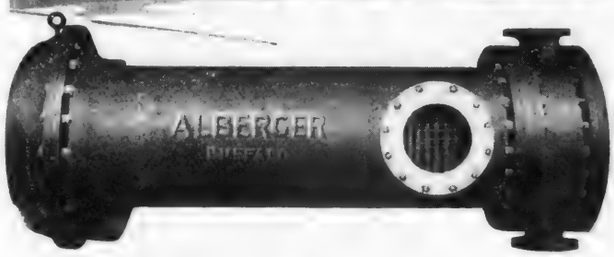

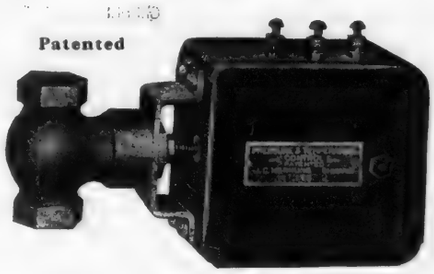

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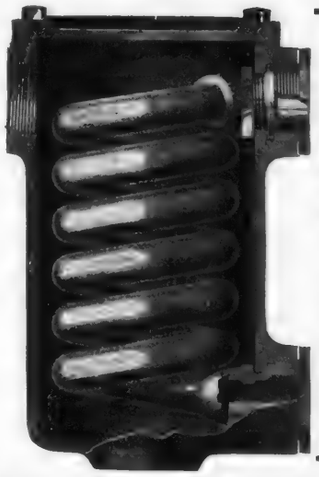

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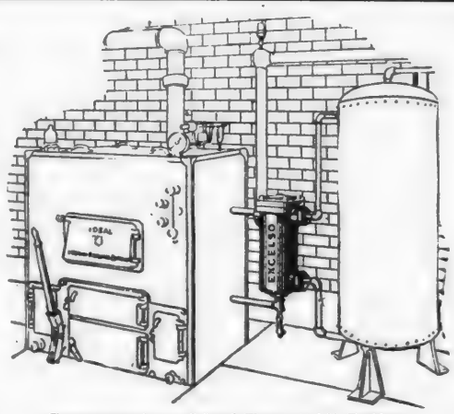

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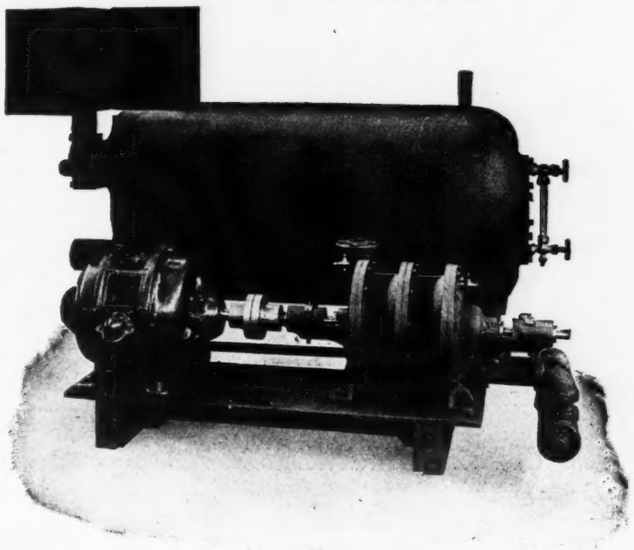

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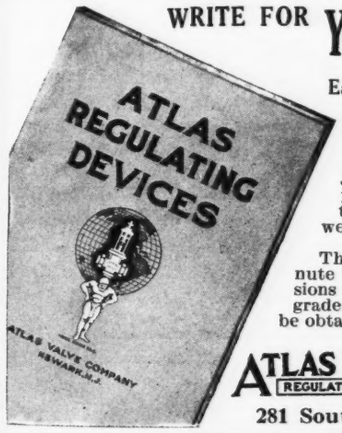

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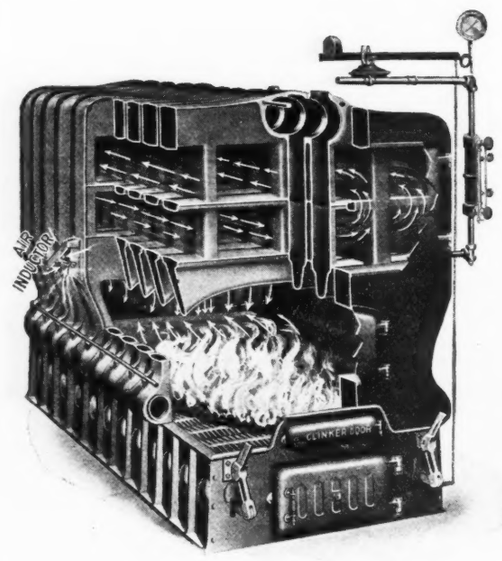

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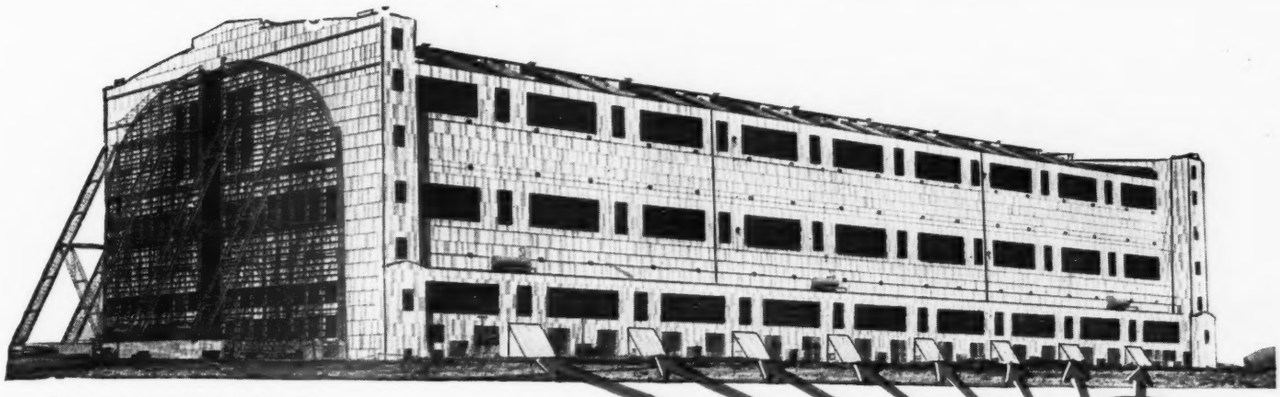
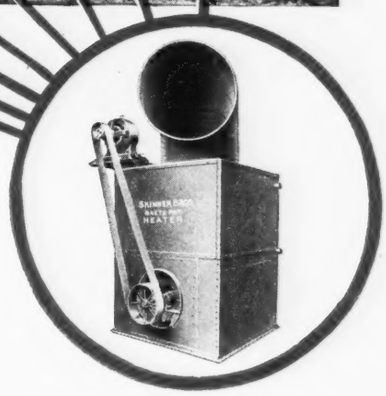


Photo by Underwood and Underwood

U. S. Government Selects Skinner Bros. (Baetz Patent) Heaters for Hangar at Lakehurst, N. J.



This enormous hangar—the largest open space ever enclosed by four walls and a roof—and originally intended to house the ZR-2 and another airship of similar size, presented the most gigantic heating problem ever encountered. Nobody ever tried to heat 40,000,000 cubic feet of open space before!

After most exhaustive tests of many kinds of heating systems, sixteen Skinner Bros. (Baetz Patent) Heaters were installed, eight along each side of the building, in specially built lean-tos, as shown by the illustration. Compared with the size of the structure, the heaters seem like merespecks, each occupying only 6x6 feet floor space.

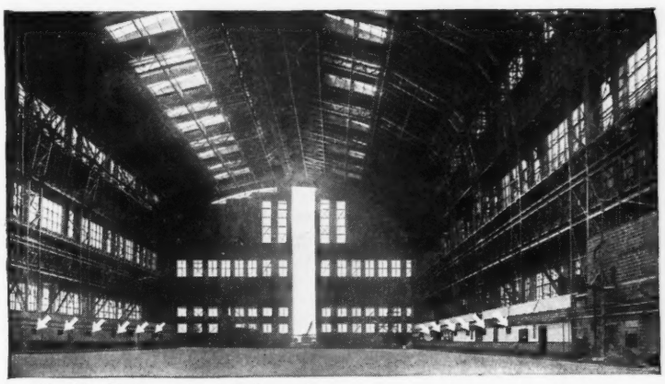


Photo by Underwood and Underwood

Partial Inside View of Lakehurst Hangar, Showing Enormous Open Space Served by Skinner Bros. (Baetz Patent) Heaters.

Illustration shows partial view of interior of hangar, which is approximately 1,000 feet long, 250 feet wide and 200 feet high. Sixteen heaters heat this vast volume of air—a feat almost as remarkable as the building itself. White arrows near the floor indicate the openings through which warm air enters building from heaters installed in lean-tos outside.

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